TREASURY DEPARTMENT

UNITED STATES COAST AND GEODETIC SURVEY

HENRY S. PRITCHETT

SUPERINTENDENT.

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BULLETIN No. 40.

SECOND EDITION—WITH ADDITIONS AND CHANGES.

ALASKA

COAST PILOT NOTES ON THE FOX ISLANDS PASSES, UNALASKA BAY, BERING SEA, AND ARCTIC OCEAN AS FAR AS POINT BARROW.

PREPARED BY THE COAST AND GEODETIC SURVEY, AND REVISED BY

LIEUT. D. H. JARVIS, U. S. R. C. S.

Bulletins are issued by the Survey from time to time as material for them accumulates. They are intended to give early announcement of work accomplished or information of importance obtained, and will, in many cases, anticipate the usual means of publication afforded by the Annual Reports.

Those already published, Nos. 1 to 25, inclusive, in quarto form, constitute Vol. I; Nos. 26 to 35, inclusive, in octavo, constitute Vol. II; Vol. III begins with No. 36.

WASHINGTON
GOVERNMENT PRINTING OFFICE
1900.

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TREASURY DEPARTMENT,

UNITED STATES COAST AND GEODETIC SURVEY OFFICE,

WASHINGTON, D. C., *April 2, 1900.*

The information contained in this bulletin relates to the Fox Islands Passes, Unalaska Bay, the coast and islands of Alaska to the eastward and northward of the passes, and the Arctic Ocean as far as Point Barrow. Bulletin No. 40, issued May 4, 1899, contained all the information available to the date of its publication. In this, the second edition of Bulletin No. 40, all later information has been added; it has been compiled in the office of the Coast and Geodetic Survey from the following sources:

Reports of United States naval officers published in Hydrographic Office Notice to Mariners.

Report of Lieut. Commander Z. L. Tanner, U. S. N., commanding U. S. Fish Commission steamer *Albatross*, from a reconnoissance of Bristol Bay in 1890.

Reports of J. F. Pratt, Assistant, Coast and Geodetic Survey, in charge of parties surveying Golofnin Bay and the passes and flats of the Yukon River in 1898 and 1899.

Reports of Assistants G. R. Putnam and R. L. Faris, Coast and Geodetic Survey, in charge of parties surveying the delta of the Yukon River, Scammon Bay, and Stuart Island in 1899.

Information collected from navigators at Seattle, Wash., by J. F. Pratt, Assistant, Coast and Geodetic Survey.

Memoranda furnished by Mr. Samuel Applegate, of Unalaska.

The information thus obtained has been revised as far as possible, and much additional matter added, by Lieut. D. H. Jarvis, U. S. R. C. S., who was detailed by the United States Revenue-Cutter Service for this duty.

As absolute accuracy in a work of this class is scarcely possible, navigators will confer a favor by notifying the Superintendent of the Coast and Geodetic Survey of errors which they may discover, or of additional matter which they think should be inserted for the information of mariners. It is the intention of the Office to extend this publication as rapidly as possible to include all portions of Alaska west of Yakutat Bay, the Aleutian Islands, and the Arctic Ocean east of Point Barrow, and the cooperation of navigators is requested to this end.

HENRY S. PRITCHETT,

Superintendent.

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UNITED STATES COAST AND GEODETIC SURVEY CHARTS AND MAPS OF BERING SEA AND ARCTIC OCEAN.

Catalogue Number.	TITLE.	Scale. Proportional.	Scale. Inches to Statute Mile.	Date of last Edition.	Price.
T	General Chart of Alaska	$\frac{1}{3,600,000}$	0.02	1899	$0.50
3091	Territory of Alaska, Southeast Section, map	$\frac{1}{1,200,000}$	0.05	1898	0.25
3092	Territory of Alaska, Southwest Section, map	$\frac{1}{1,200,000}$	0.05	1898	0.25
3093	Territory of Alaska, Northwest Section, map	$\frac{1}{1,200,000}$	0.05	1898	0.25
3094	Territory of Alaska, Northeast Section, map	$\frac{1}{1,200,000}$	0.05	1898	0.25
3098	Yukon River, map	$\frac{1}{1,200,000}$	0.05	1898	0.25
8800	Alaska Peninsula and Aleutian Islands to Seguam Pass	$\frac{1}{1,200,000}$	0.05	1899	0.50
9100	Aleutian Islands from Yunaska Island to Attu Island	$\frac{1}{1,200,000}$	0.05	1896	0.50
8981	Akun Cove, Akun Island	$\frac{1}{50,000}$	1.27	1889	0.10
8995	Pribilof Islands	$\frac{1}{20,000}$	3.17	1899	0.25
9007	Unalaska Bay, Iliuliuk and Dutch Harbors	$\frac{1}{40,000}$	1.58	1898	0.10
9008	Dutch Harbor	$\frac{1}{10,000}$	6.34	1900	0.25
9194	Harbors and Anchorages in Southwestern Alaska			1892	0.20
	Southwest Anchorage, Chirikof Island	$\frac{1}{43,000}$	1.47		
	Bay of Islands, Adakh Island	$\frac{1}{33,000}$	1.92		
	Constantine Harbor, Amchitka Island	$\frac{1}{43,000}$	1.47		
	Kiska Harbor	$\frac{1}{27,000}$	2.35		
	Cape Etolin, Nunivak Island	$\frac{1}{20,000}$	3.17		
8833	Port Moller and Heredeen Bay	$\frac{1}{80,000}$	.79	1900	0.25
9370	Cape Dyer to St. Michael	$\frac{1}{300,000}$	0.21	1899	0.50
9372	Yukon River, Aproon Mouth	$\frac{1}{80,000}$	0.79	1899	0.25
9373	Yukon River, Kwiklok Mouth	$\frac{1}{80,000}$	0.79	1899	0.25
9375	St. Michael Bay	$\frac{1}{20,000}$	3.17	1897	0.50
	Sub Sketch—				
	Pt. Romanof to St. Michael	$\frac{1}{200,000}$	0.32		
9381	Entrance to Port Safety	$\frac{1}{15,000}$	4.8	1900	0.25

U. S. Hydrographic Office Chart No. 68, Bering Sea and Arctic Ocean, and *British Admiralty Chart No. 593*, Point Rodney to Point Barrow, are useful and necessary charts in navigating these waters. *U. S. Coast and Geodetic Survey Charts Nos. 9380*, Norton Sound, scale $\frac{1}{400,000}$, and *9302* (Mercator), Bering Sea, Eastern Part, scale $\frac{1}{1,500,000}$, with a sub-etch of Port Clarence, are in preparation.

BERING SEA.

NOTE.—*In this publication all bearings are magnetic, all distances are in nautical miles.*

GENERAL REMARKS. The portions of Bering Sea here treated include the Fox Islands Passes, Unalaska Bay, and the coast and islands of Alaska lying northward and eastward of the 100-fathom line, which extends from the west end of Unimak Island to a point about 30 miles southward of St. George Island. Excepting a few localities, this territory has not been surveyed, and the charts of it are only compilations from various sources, with corrections made from later information received; the charts are necessarily imperfect and must not be followed implicitly, especially when in the vicinity of the shore. Then, too, the currents are much influenced by the winds, and are imperfectly known and difficult to predict, so that positions by dead reckoning are uncertain and safety depends upon constant vigilance.

Northward and eastward of the 100-fathom line the waters of Bering Sea shoal gradually to the coast. There are no dangers in the open sea, unless the Pribilof Islands, St. Lawrence Island, St. Matthew Island, King Island, and Diomede Islands be considered as such. These, being volcanic in character and rocky, are generally bold-to, and in approaching them in thick weather the lead can not be depended upon at all times to keep clear of them. The coast of the mainland from the head of Bristol Bay to St. Michael, including Nunivak Island, is characterized by extensive banks, formed by deposits from the rivers, which extend many miles from shore, in some cases out of sight of land. Some of these shoals are believed to be quite steep-to on their seaward faces, making it unsafe to shoal the water to less than 10 fathoms when in their vicinity.

In this region, where fog and thick weather are the rule during the season of navigation, safety, when near the coast, depends on the use of the lead, which, on account of the generally regular bottom, will indicate the approach to danger. In general, all the shores of Bering Sea and the Arctic Ocean are shallow, and when coasting it should be observed as a rule to keep the lead going constantly, and when north of St. Michael never to shoal the water to less than 5 fathoms unless feeling your way in to the land. Between St. Michael and the head of Bristol Bay the water should not be shoaled to less than 10 fathoms under the same conditions.

There are no aids to navigation. All of the rocky islands and rocky cliffs of the mainland are frequented by thousands of birds, whose numbers, constant cries, and flight serve to indicate the approach to shore at these places in thick weather.

The coast of Alaska from the head of Bristol Bay to Point Barrow and eastward has driftwood, which is brought down from the interior by the rivers and carried by the northerly currents of the sea. Good water can always be found in the vicinity of high land. Salmon are plentiful during the open season in all the streams as far north as Kotzebue Sound, and cod are very plentiful in the vicinity of the passes and in Bristol Bay.

ICE.—Except in bays and sheltered places, the ice of Bering Sea consists of detached fields, floes, and cakes, which are continually kept in motion, breaking up, piling, and telescoping by the action of variable winds and currents. At no time is the sea one solid sheet of ice, and in the winter, while it is forming, it is more scattered than in the spring, when the northerly movement has begun, and it packs closer together. The general southern limit of ice is from Bristol Bay to the vicinity of St. George Island, and thence about west-northwest to the Siberian shore. The southern edge is ragged and very much scattered, and

continued northerly winds sometimes drive fields of it far southward. As a rule, no heavy ice will be encountered south of the Pribilof Islands, and the ice in their vicinity is likely to be nothing more than detached fields.

The ice conditions in Bristol Bay have so far received little notice. Reports have been received that the bay is usually free from heavy ice between the middle of May and June 10. In 1899 the steamer *Jeanie*, of 1,000 tons and a draft of 18 feet, reached Clarks Point in Nushagak River on April 4, and was discharged on April 15. At this time the ice in the river above Fort Alexander remained solid, but two weeks afterwards it broke up and came down the river in large pieces, which would have endangered any vessel at anchor. In approaching the Nushagak River some ice was encountered about 75 miles from Cape Constantine, but not sufficient to seriously interfere with navigation. In 1896, on May 10, a vessel bound for Bristol Bay was brought up by the ice which extended from Point Moller to St. George Island, and she was not able to reach the Nushagak River until thirty days later. It is within reason to believe that some years Bristol Bay is open to navigation all winter, though the rivers and sheltered bays are closed.

In the spring, beginning with April, there is a general movement of the ice to the northward, the shores clearing ahead of the center of the sea; but it sometimes hangs in the bays and around the islands later than in the open sea. Seasons vary, the movement and position of the ice depending greatly on the direction of the winds. Generally, however, by June 1 the whole body of ice is well up with St. Lawrence Island, and a passage opens to its west side. The eastern side of the sea is likely to be obstructed a little later than the western side, and ice is often met between St. Lawrence Island and Nunivak Island in the early part of June. The breaking out of the rivers toward the latter part of May clears the shores, but the ice is likely to hold in Norton Sound several weeks later.

In general, for a vessel not fitted to encounter ice, Norton Sound is not navigable before the middle of June, often not before June 20 to 25, and has been known to be as late as July 10. On entering the sound about this time, strips of ice are often encountered after the sound can be said to be navigable. From the deck these may appear extensive and solid, but from aloft clear water may be seen beyond and through them. At the opening of navigation the ice is likely to be heaviest and to remain longest on the north shore, and, in general, it is the last of June before that part of the sound is altogether clear.

In the fall young ice begins to form on the rivers, and in the bays and sheltered places after October 1, and grows stronger and spreads according to the severity of the advancing season. Navigation is considered unsafe in Norton Sound after October 15. In the first week of October, 1897, three river steamers were frozen in in one night about 5 miles from the Apoon mouth of the Yukon River, the ice being heavy enough to walk ashore on. A strong southwest wind afterwards broke up the ice and raised the water sufficiently for them to get into the mouth of the river. On October 21, of the same year, a small steamer was frozen in and landed her cargo on the ice 1½ miles from St. Michael; afterwards the ice broke up, and the vessel was considered fortunate to get out at such a late date.

CURRENTS.—There has been no systematic study of the currents of Bering Sea, and the almost constant fogs prevent the navigator from adding much to our meager knowledge concerning them. It is said that in general the currents are greatly influenced by the tide and winds. The following observations apply to the open season, when the flow of the currents is not obstructed by ice.

Between Cape Cheerful and St. George Island the current is not believed to have any decided set or flow unless influenced by the wind. With a strong wind a current is likely to set with it, but ½ point allowance in a course will be sufficient to overcome any set that will be found in this vicinity due to this cause.

Between St. Matthew and Nunivak islands the set of the current is to the northward; with prevailing northeast winds it sets northwest, and with northwest and southwest winds, northeast. This northerly current continues and increases between St. Lawrence Island and the mainland, being stronger toward the mainland north of the mouth of the Yukon

River, where it amounts to about 1 knot, except in the early summer, when, increased by the freshets in the Yukon, it may amount to 2 knots or more.* The current sets north across Norton Sound to Sledge Island and then follows the coast to Bering Strait. It is strongly marked between Sledge Island and Bering Strait.

In Bering Strait the current sets north, and when not influenced by wind its rate is about 2 knots an hour. Protracted northerly gales, which prevail in the autumn, change its direction to the southward, but on the cessation of the wind it quickly sets north again. Strong southerly gales increase its rate to 3 knots. The current is stronger east of the Diomede Islands than west of them.

A current sets strongly from Cape Newenham through Etolin Strait.

TIDAL STREAMS.—In the southern part of Bering Sea, inside the 100-fathom line, and through the various passes in the Aleutian Islands, the tidal stream sets northward or northeastward during the rising tide, and southward or southwestward during the falling tide. In some of the passes it sometimes has a velocity of 6½ knots an hour; when clear of the passes its maximum velocity is about 2½ knots. At the Pribilof Islands, Nunivak, St. Matthew, Hall, and St. Lawrence Islands the tidal currents are strongly marked. The flood current sets eastward and northward and the ebb westward and southward. In Bristol Bay the tidal currents are very strong. They are also strong at the Kuskokwim River and north to the mouth of the Yukon, being especially so in the Etolin Strait and about Cape Vancouver.

FOG is most prevalent during spring, summer, and early fall, and it generally begins to clear about the middle of October. In summer fog is almost continuous, but few days are clear from morning to night, and the tops of the mountains can seldom be seen. At the surface of the water it is generally sufficiently clear to make out the shore at a distance of 3 or 4 miles, but at times it is so thick that nothing can be made out, and under such conditions strangers should not attempt to make the land. During the summer months the mist and fog are considered to be worse on the south side of the Aleutian Islands than on the north side in their immediate vicinity.

WEATHER.—The most striking feature about the weather in Bering Sea is its great uncertainty throughout the year. Good weather is rare and not lasting, and the winds can not be depended upon to remain long in one quarter. The late spring and summer are mild and very foggy, with frequent periods of light weather, comparatively few strong winds, and considerable rain. After September 1, gales become frequent and heavy, fogs gradually lessen, and toward the latter part of the month snow often accompanies the storms. During all the fall, gales are frequent, violent, and from almost any quarter.

During the fall and winter there are often periods of very low barometer (readings below 29.00 being common) accompanied by moderate to strong gales, with rain or snow. These gales, though sometimes very severe, are usually not so strong as would be expected by the fall of the barometer. After December and continuing into the spring there are often periods of moderate weather, and while severe gales occur, they are less frequent than in the fall. Strong winds or gales from any quarter always bring thick weather, rain, or snow. With easterly or southerly winds the rain is continuous, while with westerly or northerly winds the rain or snow occurs at intervals in squalls, and when the wind subsides the weather is likely to be clear.

Southeast storms, with falling barometer and rising temperature, are almost invariably preceded by an unusual clearness of the air; cirrus clouds are seen to the southwestward, which gradually thicken and overspread the sky. The wind usually shifts to the southwestward when the barometer ceases to fall, but it sometimes backs from southeast to northeast, and generally goes to northwest before subsiding. Upon abating, the storm is followed by light westerly winds and comparatively clear weather.

* A very strong northeasterly current setting on the Yukon flats has been observed, amounting at times to 2½ knots.

MAIL ROUTES.

From San Francisco to Unalaska, St. Michael, and points along the Yukon River: About May 25, July 25, and August 15, 1900.

From Seattle to Unalaska, St. Michael, and points along the Yukon River: About May 25, June 25, and July 25, 1900.

From Sitka to Unalaska: Once a month from April to October, 1900.

From St. Michael to Golofnin and Nome: About the 1st, 9th, 17th, and 25th of each month.

From St. Michael to Eaton, Nulato (no office), Koyukuk, and Tanana: Two round trips a month.

VARIATION OF THE COMPASS.

The magnetic variations for 1900 and annual decrease at points mentioned are as follows:

LOCALITY.	Variation.	Annual decrease.
	°	′
Cape Pankof	19 E.	4
Unimak Pass	18¼	3½
Unalaska Bay	17¾	3
Amukta Pass	16	3
St. George Island	17(?)	3½
St. Paul Island	16⅔	3
Port Moller	20¼	4
Cape Constantine	21⅔	4½
Cape Newenham	20¼	4½
West of Nunivak Island (15 miles)	18	5
Cape Upright, St. Matthew Island	15¾	5
Cape Chibukak, St. Lawrence Island	17	7
East of St. Lawrence Island (35 miles)	19	7
Cape Romanzof	19	6
St. Michael	22	6½
Unalaklik	23	6½
Cape Darby	22	7
Cape Nome	20¾	7
Sledge Island	20⅞	7
Point Spencer	20½	7
King Island	20¼	7
Diomede Islands	19½	7
East Cape	19	7
West of Cape Prince of Wales (5 miles)	19¼	7
Cape Espenberg	23½	7
Chamisso Island, Kotzebue Sound	23⅔	7
Cape Blossom	23⅓	7½
Point Hope	23	8
Cape Lisburne	23½	8½
Point Lay	26½	9½
Icy Cape	28	10
Point Belcher	29¼	10
Point Franklin	29¼	11
Point Barrow	33	12

TIDES—GENERAL TABLE.*

Note.—Tropic tides are those which occur near the time of the moon's greatest declination either north or south. The tropic lunitidal intervals are marked *a* or *b*.

a Indicates that an upper transit is to be added to the interval when the declination is north, and a lower transit to be added when the declination is south.

b Indicates that a lower transit is to be added to the interval when the declination is north, and an upper transit to be added when the declination is south.

The plane of reference referred to in the table is the plane to which the soundings on Coast and Geodetic Survey charts are reduced, and corresponds to the plane of mean lower low water.

At places where the tides are chiefly diurnal—that is, usually having only one high and one low in twenty-four hours—the interval and range of the semidiurnal tides are inclosed

in brackets. These comparatively small semidiurnal tides, having two high and two low waters each day, occur near the times of the moon's zero declination for perhaps a month or more on either side of the equinoxes.

To find the time of high or low water.—At all the stations in this table, except those having bracketed values, use the lunitidal intervals under "Mean tides" for a period of two days before and four days after the moon's zero declination, adding them to both upper and lower transits; and use the lunitidal intervals under "Tropic tides" at other times, paying attention to the marking *a* or *b*.

At places having bracketed values for "Mean tides" there is usually only one high and one low water, except within a month or more on either side of the equinoxes, at which times, for a period of two days before and four days after the moon's zero declination, use the bracketed intervals, adding them to both upper and lower transits. At other times use the lunitidal intervals under "Tropic tides," applying them according to the marking *a* or *b*.

NAME.	Geographical Position.			Lunitidal Interval.				Range of Tide.			Tropic diurnal inequality.		Tropic L. L. W. below plane of reference.
	Latitude.	Longitude.		Mean tides.		Tropic tides.							
		Arc.	Time.	High water.	Low water.	Higher high water.	Lower low water.	Mean. (Mn.)	Great tropic. (Gc.)	Mean diurnal. (Gt.)	H. W. Q.	L. W. Q.	
ALASKA.	*North.*	*West.*											
Aleutian Islands.	° ′	° ′	*h. m.*	*h. m.*	*h. m.*	*h. m.*	*h. m.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Dutch Harbor, Unalaska Island	53 53	166 32	11 06	3 50	9 58	5 45*a*	9 50*b*	2.3	5.0	4.3	1.5	4.4	0.4
Adakh Island	51 49	176 52	11 47	3 25	9 38	4 53*a*	9 32*b*	4.0	7.6	6.7	2.0	5.8	0.5
Kiska Island	51 49	182 30	12 10	3 30	9 43	4 56*a*	9 37*b*	4.1	7.7	6.8	2.0	5.8	0.5
Attu Island	52 56	186 48	12 27	3 35	9 48	4 57*a*	9 42*b*	4.5	8.3	7.4	2.1	6.1	0.5
Bering Sea.													
St. Paul Island, Pribilof Islands	57 08	170 18	11 21	4 17	10 29	6 15*a*	10 37*b*	2.1	4.0	3.5	0.6	3.5	0.3
Goodnews Bay	59 02	161 45	10 47	6 15	0 15	7 38*a*	0 21*a*	4.1	6.7	6.0	0.8	4.9	0.4
Kuskokwim Bay	59 40	161 50	10 47	6 25	0 25	7 18*a*	0 29*a*	10.1	14.2	13.2	1.3	7.7	0.5
St. Matthew Island	60 20	172 25	11 30	4 40	11 00	6 27*a*	11 08*b*	2.4	4.4	3.9	0.6	3.7	0.4
St. Lawrence Island	63 20	170 00	11 20	5 35	11 50	8 01*a*	12 01*b*	1.3	2.8	2.4	0.5	2.7	0.2
Norton Sound.													
Cape Romanzof	61 49	166 05	11 04	12 00	5 50	11 25*a*	6 15*b*	5.2	7.4	6.8	2.3	3.1	0.3
Kripuiyuk, Yukon Delta	62 20	165 19	11 01	0 50	7 10	0 08*b*	7 41*b*	3.8	5.8	5.3	2.0	2.7	0.3
Kwiklowak Pass, Yukon Delta	62 37	164 51	10 59	3 05	10 50	1 59*b*	11 39*b*	1.4	2.4	2.2	1.2	1.6	0.1
Kwikpak Pass, Yukon Delta	63 00	164 45	10 59	2 42	9 55	1 43*b*	10 39*b*	1.8	3.1	2.8	1.3	1.8	0.1
Apoon Pass, Yukon Delta	63 05	163 32	10 54	[6 50]	[1 00]	5 50*b*	2 30*a*	[1.2]	4.8	3.6	------	------	0.6
Pikmiktalik	63 16	162 34	10 50	[7 10]	[1 45]	6 10*b*	3 15*a*	[1.3]	5.0	3.8	------	------	0.6
Canal Point	63 24	162 23	10 49	[7 28]	[1 30]	6 40*b*	3 40*a*	[1.5]	4.9	3.6	------	------	0.5
St. Michael	63 29	162 02	10 48	[8 05]	[1 20]	7 06*b*	2 52*a*	[1.1]	4.5	3.3	------	------	0.6
North Bay, Stuart Island	63 37	162 30	10 50	[7 50]	[2 30]	6 50*b*	4 00*a*	[0.9]	4.1	3.0	------	------	0.6
Golofnin Bay	64 32	163 00	10 52	[6 05]	[12 00]	5 05*b*	0 05*a*	[1.0]	4.3	3.2	------	------	0.6
Cape Nome	64 29	164 46	10 50	2 49	8 26	1 34*b*	9 22*b*	1.1	4.0	3.3	1.1	1.4	0.3
Port Clarence	65 17	166 51	11 07	4 00	10 10	3 15*b*	10 43*b*	3.0	4.5	4.1	1.7	2.4	0.2
Arctic Ocean.													
Chamisso Island, Kotzebue Sd	66 15	161 45	10 47	7 45	1 50	7 34*a*	1 39*a*	1.3	1.8	1.7	0.7	0.2	0.1
Point Barrow	71 18	156 40	10 27	11 41	5 33	11 20*a*	5 12*a*	0.4	0.7	0.6	0.4	0.1	0.1
Herschel Island	69 37	138 55	9 16	4 50	11 05	5 17*a*	12 08*b*	1.8	2.9	2.6	1.6	0.9	0.1
SIBERIA.													
Bering Sea—Continued.		*East.*											
St. Lawrence Bay	65 38	189 00	12 36	[6 10]	[12 10]	5 17*b*	14 45*b*	[1.1]	4.2	3.2	------	------	0.5
Plover Bay	64 22	186 38	12 27	[5 32]	[11 32]	4 39*b*	14 10*b*	[1.1]	4.4	3.3	------	------	0.5
Anadir Bay	64 43	178 20	11 53	[6 05]	[12 05]	5 12*b*	14 40*b*	[2.6]	10.5	7.8	------	------	1.4
Cape Olintorsk	59 55	170 21	11 21	6 00	12 15	5 00*b*	12 27*b*	3.3	4.8	4.4	0.7	2.8	0.2
Bering I., Komandorski Islands	55 14	165 52	11 03	4 00	10 13	3 03*b*	10 25*b*	3.5	5.0	4.6	0.7	2.9	0.2

* Tide tables for the Pacific coast, published annually by the United States Coast and Geodetic Survey, predicting the times and heights of tides for every day of the year, can be obtained from the agents named in the list given on page 5; price, 10 cents.

TIDE TABLE—ST. MICHAEL (NORTON SOUND), ALASKA, 1900.

The harbor of St. Michael, Norton Sound, is open to navigation, on an average, by the middle of June, the time of breaking up of the ice varying from about the last week of May to the last week of June. The season of navigation usually closes in the latter part of October.

The winds in summer are generally moderate; but during September and October gales are strong and frequent, northerly winds predominating. These strong winds are of special importance to mariners on account of their effect on the height of the water; northerly and easterly winds lower the water and southerly and westerly winds raise it. With northerly winds of long duration the amount of change may be as much as 5 feet below mean low water.

The time and height of the tide at the following stations may be found by applying the differences given below to the predictions for St. Michael:

	Latitude.	Longitude.	Tidal differences.						Ratio of ranges.
				Time.		Height.			
		Arc.	Time.	H. W.	L. W.	H. W.	L. W.		
	° ′	° ′	h. m.	h. m.	h. m.	Feet.	Feet.		
Yukon R., Delta, Apoon Entr	63 02	163 14	10 53	−1 31	+0 28	−0.9	0.1		1.20
Pikmiktalik	63 16	162 36	10 50	−1 14	+0 04	+0.6	0.0		1.11
St. MICHAEL, Norton Sound	63 29	162 02	10 48	0 00	0 00	0.0	0.0		1.00
Golofnin Bay, Norton Sound	64 32	163 00	10 52	−1 45	+3 02	−0.1	0.1		0.98
Port Clarence	65 17	166 51	11 07	−1 04	+0 48	−0.0	0.0		1.00

JUNE.

Moon.	Day of— W.	M.	Time and Height of High and Low Water.			
	F	1	9:46	18:55		
			4.1	−0.6		
	S	2	10:32	19:18		
			3.8	−0.4		
	S	3	11:24	19:37		
			3.3	−0.3		
☽	M	4	12:10	19:54		
			2.8	−0.1		
E A	Tu	5	13:04	20:12		
			2.3	0.0		
	W	6	13:55	20:34		
			1.7	0.1		
	Th	7	5:03	13:08	15:05	21:00
			2.8	1.2	1.5	2.8
	F	8	5:20	14:00		
			3.1	0.8		
	S	9	5:40	14:45		
			3.3	0.3		
	S	10	6:00	15:32		
			3.6	0.1		
	M	11	6.25	16:16		
			3.9	−0.2		
S ○	Tu	12	6:52	17:00		
			4.2	−0.4		
	W	13	7:26	17:35		
			4.4	−0.6		
	Th	14	8:00	18:08		
			4.5	−0.6		
	F	15	8:37	18:36		
			4.5	−0.5		
	S	16	9:19	18:47		
			4.2	−0.4		
	S	17	10:08	18:55		
			3.9	−0.3		
P E	M	18	11:00	19.00		
			3.3	−0.2		
☾	Tu	19	11:50	19:12		
			2.7	0.0		
	W	20	3 00	7:20	12:50	19:35
			2.1	1.5	2 1	0.1
	Th	21	3:23	10:50	13:56	20:02
			2.7	1.4	1 5	0.2
	F	22	3:53	12:28		
			3.3	0.7		
	S	23	4:29	13:35		
			3 7	0.2		
	S	24	5:09	14:30		
			4.2	−0.2		
N	M	25	5:51	15:20		
			4.5	−0.5		
●	Tu	26	6:35	16:02		
			4.6	−0.7		
	W	27	7:17	16:43		
			4.6	−0.7		
	Th	28	7:58	17:19		
			4.5	−0.6		
	F	29	8:41	17:48		
			4.2	−0.5		
	S	30	9:22	18:12		
			3.8	−0.3		

JULY.

Moon.	Day of— W.	M.	Time and Height of High and Low Water			
	S	1	10:05	18:35		
			3.4	−0.2		
E	M	2	10:48	18:42		
			2.9	0.0		
A	Tu	3	11:28	18:48		
			2.3	0.1		
☽	W	4	3:40	19:05		
			2.4	0.1		
	Th	5	3:55	19:35		
			2.6	0.2		
	F	6	4:05	19:55		
			2.9	0.3		
	S	7	4:22	20:02		
			3.3	0.3		
	S	8	4:45	14:34		
			3.5	0.2		
S	M	9	5:07	15:10		
			3.8	0.1		
	Tu	10	5:40	15:50		
			4.2	−0.3		
	W	11	6:16	16:24		
			4.4	−0.5		
	Th	12	6:57	16:53		
			4.5	−0.4		
	F	13	7:37	17:08		
			4.4	−0.3		
	S	14	8:23	17:18		
			4.2	−0 2		
P	S	15	9.10	17.23		
			3 8	0.0		
E	M	16	10.04	17:30		
			3.3	0.1		
	Tu	17	1:16	4:15	10:58	17:54
			1.6	1 4	2.7	0.2
☾	W	18	1:32	6:07	11:58	18:26
			2.0	1.5	2 1	0.3
	Th	19	1:52	8:25	13:03	18:55
			2.6	1.3	1.5	0.3
	F	20	2:35	10:52	14:12	19:24
			3.1	0.8	1.5	0.2
	S	21	3:18	12:10	17:07	19:45
			3.6	0 3	0.8	0.2
N	S	22	3:57	13:10		
			4.0	0.0		
	M	23	4:28	13:47		
			4.2	−0.3		
	Tu	24	5:10	14:34		
			4.3	−0.5		
	W	25	5:55	15:12		
			4.3	−0.5		
●	Th	26	6:40	15:48		
			4.2	−0.3		
	F	27	7:20	16:15		
			3.9	−0.1		
	S	28	8:03	16:30		
			3.6	0.1		
E	S	29	8:47	16:35		
			3.2	0.2		
A	M	30	9:37	16:45		
			2.7	0.3		
	Tu	31	10:20	17:03		
			2.2	0.3		

The tides are placed in the order of occurrence, with their times on the first line and heights on the second line of each day; a comparison of consecutive heights will indicate whether it is high or low water.

The time used is Mean Local Civil for the meridian 165° W.; 0^h is midnight, 12^h is noon; all hours less than 12 are in the morning, all greater are in the afternoon, and when diminished by 12 give the usual reckoning; for instance, 15^h is 3 p. m. The heights, in feet and tenths, are reckoned from the Plane of Mean Diurnal Low Water, which is approximately the datum of soundings on the Coast and Geodetic Survey Charts for this region, and which is 1.5 feet below mean sea level. Symbols and abbreviations relating to the moon: ●, new moon; ☽, 1st quar.; ○, full moon; ☾, 3d quar.; E, moon on the equator; N, S, moon farthest north or south of the equator; A, P, moon in apogee or perigee.

TIDE TABLE—ST. MICHAEL (NORTON SOUND), ALASKA, 1900.

AUGUST.

Moon.	Day of— W.	M.	Time and Height of High and Low Water.			
	W	1	1:21 2.1	7:24 1.4	11:10 1.8	17:33 0.4
	Th	2	1:37 2.4	10:05 1.4	12:05 1.5	18:00 0.5
☽	F	3	2:05 2.7	18:17 0.6	. . .	. . .
	S	4	2:30 3.0	12:07 0.7	. . .	. . .
	S	5	3:00 3.3	12:50 0.3	. . .	. . .
S	M	6	3:32 3.6	13:32 0.1	. . .	. . .
	Tu	7	4:10 3.8	14:05 —0.1	. . .	. . .
	W	8	4:48 4.0	14:34 —0.1	. . .	. . .
	Th	9	5:32 4.1	14:58 —0.1	. . .	. . .
○	F	10	6:17 4.0	15:08 0.0	. . .	. . .
	S	11	7:06 3.8	15:16 0.2	. . .	. . .
P E	S	12	0:10 0.9	7:58 3.5	15:25 0.3	22:04 1.5
	M	13	1:40 1.0	8:50 3.1	15:45 0.5	22:36 1.7
	Tu	14	3:10 1.2	9:52 2.5	16:15 0.5	23:16 2.2
	W	15	4:46 1.2	10:57 1.9	16:46 0.6	23:50 2.6
	Th	16	6:28 1.0	12:06 1.5	17:18 0.6	. . .
☾	F	17	0:38 3.0	8:20 0.8	13:15 1.5	17:51 0.6
N	S	18	1:29 3.4	10:11 0.4	14:50 2.0	18:24 0.7
	S	19	2:20 3.7	11:18 0.0	. . .	. . .
	M	20	3:10 3.9	12:12 —0.1	. . .	. . .
	Tu	21	4:00 3.9	13:00 —0.1	. . .	. . .
	W	22	4:48 3.9	13:40 —0.1	. . .	. . .
	Th	23	5:35 3.7	14:15 0.1	20:30 1.7	22:31 0.9
●	F	24	6:20 3.4	14:38 0.3	20:54 1.7	23:40 1.2
	S	25	7:05 3.1	14:55 0.5	21:31 1.5	. . .
E	S	26	0:55 1.4	7:54 2.8	15:10 0.6	22:07 1.7
A	M	27	2:12 1.4	8:47 2.3	15:25 0.7	22:38 2.0
	Tu	28	3:27 1.4	9:36 1.9	15:41 0.8	22:58 2.2
	W	29	5:00 1.4	10:32 1.5	16:02 0.9	23:25 2.4
	Th	30	7.10 1.3	11:30 1.5	16:24 0.9	23:57 2.6
	F	31	8:57 0.9	12:30 1.8	16:40 0.9	. . .

SEPTEMBER.

Moon.	Day of— W.	M.	Time and Height of High and Low Water.			
☽	S	1	0:34 2.9	9:56 0.6	. . .	. . .
S	S	2	1:12 3.1	10:50 0.4	. . .	. . .
	M	3	1:56 3.4	11:28 0.2	. . .	. . .
	Tu	4	2:38 3.5	12:03 0.1	. . .	. . .
	W	5	3:27 3.6	12:30 0.1	. . .	. . .
	Th	6	4:15 3.6	12:35 0.2	. . .	. . .
	F	7	5:10 3.5	12:47 0.3	. . .	. . .
○ E	S	8	6:03 3.2	13:11 0.5	19:36 1.5	. . .
P	S	9	0:00 1.0	6:58 2.9	13:36 0.7	20:08 1.8
	M	10	1:14 0.9	8:00 2.5	14:11 0.8	20:47 2.2
	Tu	11	2:35 0.8	9:08 2.1	14:38 0.9	21:23 2.6
	W	12	3:46 0.7	10:14 1.6	15:07 0.9	22:04 3.0
	Th	13	5:07 0.5	11:28 1.5	15:38 0.9	22:55 3.3
	F	14	6:43 0.4	12:48 1.3	16:10 0.8	23:47 3.5
N ☾	S	15	8:18 0.2	14:15 1.0	. . .	. . .
	S	16	0:45 3.7	9:25 0.0	. . .	. . .
	M	17	1:39 3.7	10:30 0.0	. . .	. . .
	Tu	18	2:32 3.6	11:14 0.0	. . .	. . .
	W	19	3:30 3.4	11:47 0.2	18:20 1.5	21:12 1.4
	Th	20	4:18 3.1	12:11 0.3	18:48 1.5	22:27 1.4
	F	21	5:14 2.8	12:30 0.5	19:18 1.7	23:43 1.4
E	S	22	6:13 2.5	12:50 0.7	19:46 1.9	. . .
● A	S	23	1:05 1.3	7:08 2.1	13:10 0.8	20:07 2.2
	M	24	2:18 1.2	8:02 1.8	13:26 0.9	20:28 2.4
	Tu	25	3:26 1.1	9:00 1.5	13:44 1.0	21:00 2.6
	W	26	4:28 1.0	10:15 1.5	14:02 1.0	21:32 2.8
	Th	27	5:55 0.8	22:04 3.0	. . .	. . .
	F	28	7:10 0.5	22:42 3.2	. . .	. . .
S	S	29	8:00 0.3	23:32 3.3	. . .	. . .
	S	30	8:45 0.2	. . .	. . .	. . .

OCTOBER.

Moon.	Day of— W.	M.	Time and Height of High and Low Water.			
☽	M	1	0:07 3.4	9:15 0.0	. . .	. . .
	Tu	2	0:58 3.5	9:40 0.0	. . .	. . .
	W	3	1:55 3.4	10.02 0.0	. . .	. . .
	Th	4	2:57 3.2	10:30 0.2	17:45 1.5	21:00 1.4
	F	5	3:58 3.0	10:54 0.4	18:02 1.6	22:23 1.4
E	S	6	5:00 2.6	11:22 0.5	18:20 2.0	23:42 1.1
P	S	7	6:05 2.2	11:57 0.8	18:44 2.4	. . .
○	M	8	1:00 0.9	7:13 1.9	12:22 0.9	19:14 2.9
	Tu	9	2:02 0.5	8:23 1.6	12:48 1.9	19:53 3.2
	W	10	3:22 0.4	9:42 1.5	13:12 0.8	20:40 3.6
	Th	11	4:15 0.0	21:26 3.8	. . .	. . .
N	F	12	6:02 —0.2	22:16 3.9	. . .	. . .
	S	13	7:07 —0.3	23:08 3.9	. . .	. . .
☾	S	14	8:02 —0.3	. . .	. . .	. . .
	M	15	0:00 3.7	8:46 —0.3	. . .	. . .
	Tu	16	0:51 3.5	9:20 —0.1	. . .	. . .
	W	17	1:53 3.2	9:45 0.0	17:23 1.6	20:20 1.4
	Th	18	2:54 2.8	10:05 0.2	17:47 2.1	22:05 1.5
E	F	19	3:55 2.4	10:22 0.4	18:03 2.2	. . .
A	S	20	0:02 1.5	4:50 1.9	10:48 0.5	18:20 2.4
	S	21	1:40 1.2	5:52 1.6	11:13 0.7	18:42 2.7
	M	22	2:46 0.9	7:00 1.5	11:34 0.8	19:13 2.9
●	Tu	23	3:50 0.7	19:38 3.2	. . .	. . .
	W	24	4:42 0.5	20:07 3.4	. . .	. . .
	Th	25	5:31 0.2	20:35 3.6	. . .	. . .
	F	26	6:11 0.0	21:09 3.7	. . .	. . .
S	S	27	6:46 —0.1	21:46 3.8	. . .	. . .
	S	28	7:12 —0.3	22:30 3.7	. . .	. . .
	M	29	7:35 —0.3	23:10 3.6	. . .	. . .
☽	Tu	30	7:56 —0.3	23:45 3.3	. . .	. . .
	W	31	8:25 —0.2	. . .	. . .	. . .

The tides are placed in the order of occurrence, with their times on the first line and heights on the second line of each day; a comparison of consecutive heights will indicate whether it is high or low water.

The time used is Mean Local Civil for the meridian 165° W.; 0^h is midnight, 12^h is noon; all hours less than 12 are in the morning, all greater are in the afternoon, and when diminished by 12 give the usual reckoning, for instance, 15^h is 3 p. m. The heights, in feet and tenths, are reckoned from the Plane of Mean Diurnal Low Water, which is approximately the datum of soundings on the Coast and Geodetic Survey Charts for this region, and which is 1.5 feet below mean sea level. Symbols and abbreviations relating to the moon: ●, new moon; ☽, 1st quar.; ○, full moon; ☾, 3d quar.; E, moon on the equator; N, S, moon farthest north or south of the equator; A, P, moon in apogee or perigee.

ICE CONDITIONS AND FIRST ANNUAL ARRIVAL OF VESSELS AT ST. MICHAEL, ALASKA.

(From records of Alaska Commercial Company.)

YEAR.	Ice Moving out of St. Michael Bay.	First Arrival from Yukon River.	First Arrival from Sea.	Ice Forming in St. Michael Bay.
1878	----------	----------	July 1.	Oct. 18–22.
1879	----------	----------	June 22.	Oct. 21–25
1880	June 22.	----------	June 28.	Oct. 20–27.
1881	June 10.	----------	June 19.	Nov. 7.
1882	June 8.	June 17.	June 24.	Oct. 23.
1883	June 1.	June 10.	June 22.	Nov. 6.
1884	June 10.	June 17.	----------	Oct. 6.
1885	----------	----------	June 24.	----------
1886	June 11.	----------	June 20.	Oct. 22.
1887	----------	June 15.	June 20.	Oct. 29–Nov. 6.
1888	May 31	June 8.	June 25.	Oct. 22–31.
1889	June 9.	June 13.	July 4.	Nov. 10–16.
1890	June 3.	June 6.	July 13.	Oct. 25–Nov. 9.
1891	June 6.	June 7.	June 29.	Nov. 6.
1892	June 11.	June 7.	June 18.	Oct. 29.
1893	June 10.	June 14.	June 24.	Nov. 7.
1894	June 15.	June 18.	June 25.	Oct. 26.
1895	June 18.	June 19.	June 29.	Oct. 24–Nov. 4.
1896	June 25.	June 27.	July 7.	Nov. 2.
1897	June 14.	June 22.	June 26.	Oct. 18–21.
1898	June 13.	----------	June 13.	Oct. 20–31.
1899	June 10.	June 16.	June 17.	----------

ISANOTSKI STRAIT.

The navigation of this pass attracts attention as it has been used to some extent by light-draft craft built in Puget Sound ports for service on the Yukon River. It is the practice for these vessels to go through the inland passages of Southeast Alaska, out through Cross Sound, and coast around, watching the weather, going behind the islands off Alaska Peninsula and through Isanotski Strait or Unimak Pass. Isanotski Strait is preferable to Unimak Pass for light-draft river vessels because it is nearer and has many sheltered anchorages and places where fresh water can be obtained. Between twelve and twenty vessels were taken through this strait in 1898, and it might be more generally used if more was known about its northern entrance, which is considered dangerous, on account of the uncertain knowledge of the location of the dangers, and want of information regarding the strong tidal currents, which are affected by strong northerly or southerly winds.

There is a very extensive shoal, or flat, in the northern and widest portion of the strait, lying to the eastward of the channel way and southward of the outlet into Bering Sea. Just outside of this outlet, at a distance supposed to be between 1 and 2 miles, is a line of shoals, with breakers, which extend from the northeast point of Unimak Island in a northeasterly direction for 5 or 6 miles parallel with the coast.

The following has been orally communicated by Capt. J. L. Fisher, who commanded one of the eleven Moran stern-wheel steamboats that went through the pass in company during the summer of 1898:

"In entering from the eastward, it is desirable, in passing through Ikatan Bay, to stand well over toward its northwestern shore, then head up for the easterly side of the entrance to the strait, thus giving the rocks on the westerly point inside its entrance a good berth. When past these rocks, cross back to the west side of the pass to clear the spit making off the sharp point of the eastern shore of the narrows. Then, if bound through, keep the westerly side until the northeast end of Unimak Island is reached.

"Abreast Morzhovoi Peninsula there is a large shoal in the middle of the pass, which must be avoided by keeping to the westward of it. In the northern and widest portion of the pass there is a very extensive shoal, with the channel along its western edge. This shoal extends very close to the northeast point of Unimak Island, the channel between the

CAPE PANKOF, SW., DISTANT 6 MILES.

point and the shoal being quite narrow, with the least depth of water of any place known in the strait, there being not more than 12 feet.

"From close inside the northwest point the channel crosses the entrance and passes just outside the very long and low northeast point, with about 18 feet of water, for 2 or 3 miles, parallel with and between the shore of the peninsula and the offshore shoal with breakers, until the latter is passed, when the course can be squared away out into Bering Sea." Applegate shows the channel as leading close to the end of the sandspit on the northeast point of Unimak Island and then to the westward close to the northern side of the sand spit, between the latter and the shoal lying off the outlet of the strait.

"**Morzhovoi Peninsula** is a high promontory, but the neck connecting it with the mainland is very low. This, with the low country to the northeastward, extending from the east side of the north entrance to the strait all the way to Cape Glasenap, allows the north and northeasterly winds to blow across the northerly and wider portion of the strait and draw through Morzhovoi Bay with a great deal of force.

"There is a rocky spit making off the southwest point at the entrance to Morzhovoi Bay."

Tides.—There is little known regarding the tides in Morzhovoi Bay, except that they are much influenced by the winds. It is reported that the current in the strait runs north 15h. 30m., and south 8h. 30m. In the narrow part of the strait south of Morzhovoi Bay, the tidal current is said to attain a velocity of from 7 to 9 knots.

ANCHORAGES.

Lieut. Commander F. J. Drake, U. S. N., commanding U. S. S. *Albatross*, 1895, says:

"In **Ikatan Bay** good holding ground is found in a small cove immediately west of Ikatok Point, on the south side of the bay, which offers good protection with winds from southeast to southwest. For winds from northeast to northwest, a safe anchorage is found on the north side of the bay west of Sankin Island, close to and under the bluff east of the entrance to the strait. Both anchorages are free from the rush of the tidal current, which has a velocity of 7 to 9 knots in the pass.

"**Morzhovoi Bay.**—Morzhovoi Village is situated on a low, sloping bluff terminating in a rocky and gravelly spit on the south shore of Morzhovoi Bay. Fresh water can be obtained at the southeast corner of the bay, near the village. An anchorage may be made in the middle of the bay off the village, with the Greek church bearing **S.** ¼ **E.**, depth 4½ fathoms, muddy bottom and good holding ground. A high bluff on the north side forms a good protection from northerly winds, which, however, are drawn through the bay with much force at times from the eastward."

COAST FROM ISANOTSKI STRAIT TO UNIMAK PASS.

PROMINENT FEATURES.

Sannak Islands.—The most noticeable features of Sannak Island are the closely connected peaks eastward of Acherk Harbor and the numerous outlying rocks and islands. Sannak Peak, 1,850 feet high, has been seen from the westward at a distance of 65 miles. It is thought that these Islands are a few miles southward and eastward from their positions as given on the chart. The vicinity of Sannak Islands is extremely dangerous, and no effort should be made to make Sannak Peak as a landmark from the southward. The numerous reefs and rocks surrounding the islands, especially on their southern and western sides, and their uncertain positions, should warn the navigator to give them a wide berth.

Cape Pankof has three rugged points close together, and there is a reef partially above water extending about ¼ mile **E.** by **S.** from the middle point. The land back of the cape is low, so that at a distance the cape appears as an island. A reef makes off eastward from the cape for a distance of about ¼ mile, and tide rips and broken water extend some distance off the cape.

Cape Lazaref is a rocky point with a ledge extending from it **SE.** about 1 mile; there are three rocks above water nearly equidistant from the cape. There are two bold, rocky points immediately east of Cape Lazaref, with small beaches between them. In fact, the cape might be said to be formed by three points, as they all lie within 1½ miles.

The **Promontory** forms the western end of Unimak Bay. On the northern and southern sides it slopes away gradually, while the crest (grass-covered in summer) is joined to the central mountain system of Unimak Island by a lower connecting ridge. The seaward face terminates in a vertical cliff having a low rocky foot with outlying ledges, and a small rocky islet off it.

From the Promontory a low belt of land extends southward to a steep **hill,** which lies northeastward of Cape Khituk. It is apparently composed of volcanic rock and detritus, about 700 feet high, detached from the interior high lands by intervening valleys. The seaward face is a bluff, with detritus at its foot, partly covered during the summer with grass and sloping toward the water. It is an important landmark.

ANCHORAGES.

Acherk Harbor, on the northwest end of Sannak Island, is said to be a good harbor for all but northwest winds. It is small, however, and, being out of the way, would not be generally used. The inner portion of the harbor is about ¼ mile wide, and there is an anchorage in about 4 fathoms in the middle, about ⅛ mile from the beach at the head. The neck connecting Petrof Point, on the west side of the harbor, with the main part of the island is low and covered at very high tides. There are several native houses in the southeast part of the harbor, which are visible from a considerable distance when not shut in by the hill on Petrof Point. The best landing is on the beach near the village; there is a wharf in the southeast corner of the harbor. A rock on which the sea breaks lies about 200 yards **NW.** by **W.** from the rock at the east point at the entrance to the harbor.

Ikatan Bay affords good protection in southerly winds (see page 15).

East Anchor Cove affords good anchorage and shelter from westerly and southerly to southeast winds. There are detached rocks off the east point at the entrance to the cove close in to the shore. There are no dangers inside the cove; the bottom shoals gradually to the shores.

Approaching from the southward, round Cape Paukof and give the land a berth of about 1 mile. After passing the high land at the end of the cape the cove opens out, with low land at its head. Enter the cove in mid-channel and anchor in about 5 fathoms. Approaching from the northeastward, keep a sharp lookout for the breakers on a sunken rock about **NNE.** ¼ **E.,** distant about 3 miles, from the cove.

There is good anchorage in the middle of **West Anchor Cove,** in 5 to 9 fathoms, and the eastern point at the entrance bearing about **S.** There is a reef of rocks close-to off the southeast point of the cove.

Lords Harbor, locally known as **Dora Harbor,** affords good anchorage with northerly winds, but with heavy southwesterly winds considerable swell sets in. It is out of the way and little used. Bird Island, high and cone-shaped, marks the entrance. From the Island a kelp reef, having two rocks about 10 feet out of water, extends to the western point at the entrance. The following are the directions given by Capt. M. A. Healy, U. S. R. C. S., commanding the U. S. S. *Corwin*, in 1885:

"To enter, bring the west side of the entrance to the harbor to bear **NW.**, and steer for it on this bearing until Bird Island bears **S.**; then steer **N.** for the middle of the entrance and anchor in 4½ to 5 fathoms, with the west side of the entrance bearing **SW.** and the east side **SSE.** ½ **E.**"

An anchorage for small vessels exists under the northeast side of **Cape Lazaref,** but no directions can be given.

Promontory Cove, close under the west side of the promontory, is indicated by Applegate as an anchorage, with 7 to 9 fathoms water.

FOX ISLANDS PASSES.

From the southward and eastward, bound for Bering Sea, there are three passes used by deep-draft vessels, known collectively as the Fox Islands Passes, and respectively as Unimak, Akutan, and Unalga passes. The largest and most desirable one to use in thick and foggy weather is the eastern one, Unimak Pass. This is clear of hidden dangers, the widest of the three, and is comparatively free from tide rips. It is especially recommended for sailing vessels, and for steamers bound direct to the northward. Akutan and Unalga passes are convenient for steam vessels bound to Unalaska Bay, but, being narrow and having strong currents and tide rips at times, are not recommended for sailing vessels bound north. A fair wind is almost necessary for the passage, and from the southward this would bring fog. The pass between Ashmiak and Ugamok islands on the east and Sea Lion Island on the west is thought to be clear of dangers, but it is not recommended. All of the other minor passes between Unimak and Akutan passes are known to be full of rocks and reefs, and should not be attempted under any circumstances.

The mountains in this vicinity would be excellent landmarks if they could be seen, but in summer they are almost always obscured by fogs or low-lying clouds. The lower hills and islands and objects near the sea level furnish the available landmarks. In coming from the southward or eastward in clear weather, and if bound through Akutan or Unalga passes, it is recommended to steer for Tigalda Island as the first land to be made. It is high and prominent, and when once made a course can be shaped for any of the three passes.

SOUNDINGS.—To the southward of the passes the 100-fathom curve is found from 20 to 40 miles offshore, and when inside of this depth the color of the water will have changed from dark blue to light green. This change in the color of the water is the best indication the mariner has in thick weather to warn him of his approach to land and that he is on soundings. Southwest of Unimak Pass the 50-fathom curve is from 3 to 5 miles offshore, and in thick weather the greatest caution should be used in approaching inside of this depth. Southeast of Unimak Pass the water shoals rapidly from 100 fathoms to Davidson Bank, on which a least depth of 37 fathoms is marked 33 miles from Ugamok Island.

PROMINENT FEATURES.

Shishaldin Volcano, nearly 9,000 feet high, is cone-shaped and very regular in outline, with faint wreaths of smoke and vapor at times drifting from its blackened tip. It is for the most part snow-clad, except where the rocky cliffs and projections afford no lodgment.

Isanotski is seen close to the eastward of Shishaldin, very rugged, and having a broken or castellated double peak. The summit is bare and looks as though composed of great vertical rock masses.

Pogrumnoi Volcano, over 5,500 feet high, is a rugged, snow-clad peak, with dark vertical ridges cropping through the snow. From a flat-topped dome, apparently as high as Pogrumnoi, but seemingly not connected with it, there extends a long, high, snow-covered table-land, dipping gradually toward Cape Khituk. Except the snow-covered portions, the general color is green during July and August, from the grass-covered slopes. Pogrumnoi is a guiding landmark in clear weather in making Unimak Pass.

Ugamok Island is rugged in outline, with bold rocky cliffs. It is highest at the eastern end, where there is a sharp conical peak, which is very conspicuous, and may often be seen when the summits of the higher islands in the vicinity are obscured by fog. The northern and eastern sides of the island are free from dangers.

Tigalda Island is high and prominent, with distinctly rounded hills, resembling knuckles. The southern shore of the island can be approached as close as 1 mile. The northern and northwestern sides of the island are foul and should not be approached.

Avatanak Island is highest at its eastern end, where it terminates in a bold cliff; toward the western end, which is low, is a pile of very prominent rocks, resembling a

ruined castle. The hills are not rounded like those of Tigalda, but are rugged and torn. The southern shore is apparently safe.

Rootok Island, lying westward of Avatanak Island and separated from the latter by a foul passage, is high, bold, and abrupt, and about 3 miles long in a general **ENE.** and **WSW.** direction. The shores of this island are apparently free from outlying dangers.

Akutan Island is 3,332 feet high. The volcano is a rugged cone, with generally a faint column of smoke issuing from its northeast side near the top. The north side of the island is a fairly regular slope, breaking off at the coast in steep cliffs. The south side is more irregular and the cliffs at the coast are higher and more rocky and broken. In summer the lower parts of the island are grass-covered. **Cape Morgan,** the southwest point, is high and very bold and precipitous. A shelf of dark rock is at the base of the cliffs, and a reef having three pinnacle rocks above water extends off the cape about ¼ mile.

Unalga Island is comparatively low, with a steep ragged shore line of cliffs surrounded by detached pinnacle rocks. The top of the island is covered with grass and shows up well against the dark hills beyond. There is a reef which extends about 200 yards off the northwest end of the island.

Gull Rocks lie off the northeast side of Unalga Island. The group consists of four small islets, standing well out of the water and less than ½ mile from Unalga Island. There are many detached rocks in the same group, but not extending beyond the islets into Akutan Pass.

Egg Island, situated a short distance northward from Biorka Island, is a landmark for Unalga Pass. It is moderately high, rather ragged on top, dark in color, and has a comparatively rounded outline. There is a good passage between the island and Cape Biorka, with a depth of 35 fathoms. When the island bears about **SW.** by **S.,** a small island, detached from the main island, will open out on its southeastern end. A dark pinnacle rock, showing plainly, lies close to the north end of the island. The shores of the island are free from dangers.

The Signals are two low, barren rocks, about 3 miles southward of Egg Island. The channel between them and Biorka Island is clear, with a depth of 10 fathoms. A sunken rock is just outside the Outer Signal.

Old Man is a small, square-topped rock, about 60 feet high, lying about ½ mile northwest from Egg Island. There is a low, round-topped rock close to the Old Man. Old Man stands out well clear from Egg Island and, in thick weather, serves as an excellent mark by which to recognize Egg Island.

DANGERS APPROACHING FROM THE SOUTHEASTWARD.

Anderson and Lenard Rocks.—The existence and position of these rocks are doubtful; they are believed to be one and the same rock, though reported in different localities. Commander Z. L. Tanner, of the U. S. S. *Albatross*, has searched for them without success, but is convinced that some danger exists in that locality.

It is reported that there is a rock awash at low water in approximately latitude 54° 03′ N., longitude 162° 48′ W., or with Sannak Peak bearing **N.** by **W.** ¾ **W.,** distant 27 miles. This may be the Anderson Rock referred to above.

It is reported that foul ground exists between the above-mentioned rocks and Sannak Island.

Aleks Rock, on which the sea breaks in a well-defined breaker, is about 20 feet across, and lies with Sannak Peak bearing approximately **NE.,** distant 19 miles. (See also Sannak Island, page 15.)

TIDAL CURRENTS.—In the vicinity of the passes and in the passes the tidal currents are strong and their directions uncertain, and it is recommended that precautions be taken in thick weather to avoid being carried unawares into dangerous localities. In navigating in this vicinity it is necessary to make allowance for the current setting into or out

PINNACLE ROCK, SCOTCH CAP, ENE. ½ E.

CAPE MORGAN, WNW., DISTANT 8 MILES.

AKUTAN ISLAND.

of the passes. The current sets southward during the falling tide and northward during the rising tide, which is the longer and stronger of the two. Its velocity varies, but in Unalga Pass, where it is greatest, it has been found to be 6½ knots an hour during the whole of the tide, and the current turned to the opposite direction at the same velocity in twenty minutes. It is believed, however, that such a velocity of the current is very unusual in any of these passes, and that at ordinary times the tidal current does not amount to more than three or four knots. Until very recently the class of vessels navigating these waters has been low-powered, with an average speed of from 6 to 9 knots, and, in an experience covering many years, it is not recalled or known when these vessels have experienced serious trouble in going through at any stage or condition of the tide when not influenced by strong winds.

On the Bering Sea side of Unalga and Akutan passes, with a strong northerly or northwesterly wind, heavy **tide rips** are raised. These do not extend through the passes, but seem to be confined to the Bering Sea side from about the middle of Unalga Island almost to Cape Kalekhta. With the ebb tide, a southerly wind does not seem to raise corresponding rips on the Pacific side. When the tide rips are heavy, the water is broken into heavy, choppy seas from every direction, making it difficult to control the ship. In H. M. S. *Nymphe*, in 1893, while passing through Unalga Pass, all hatchways on deck were obliged to be closed, as the water broke on board in every direction with great force, and a speed of 9 to 10 knots was necessary to control the vessel. Unimak Pass is comparatively free from tide rips.

In ordinary weather it is high or low water in Akutan Pass between one and two hours before high or low water at Dutch Harbor.

THROUGH UNIMAK PASS TO CAPE KALEKHTA.

PROMINENT FEATURES.

Cape Khituk, locally known as **Seal Cape**, is about 150 feet high, with a vertical rocky face and grassy slopes on either side. There is no island off the cape and no rocks were seen disconnected from the shore.

In the vicinity of **Scotch Cap** the bluffs are reddish gray, with a dark pinnacle rock at the base of the bluffs. A short distance east of it is a large rock standing on the grassy slope near the beach and having the appearance of a hut or barabara. Westward of Scotch Cap a stream enters the sea, which from the westward shows a cascade but is not visible from the southward. A breaker is reported as being about 3 miles northwestward of Scotch Cap and about ½ mile from the shore.

Cape Saritchey is comparatively low and steep-to with detached rocks close inshore, around which strong tidal currents sweep.

Ugamok Island is described on page 17.

Akun Head, the northern end of Akun Island, is a high massive head with a nearly vertical sea face; it has a high grass-covered (in summer) saddle to the southward.

North Head, of Akutan Island, consists of two high ridges, separated by a grassy valley. The eastern one is the more abrupt and extends farther northwest, having on the eastern side a bold bluff which seems to dip into a low valley. The bluff is of a warm reddish color, with the stratification dipping slightly northwestward.

Flat Top Rock, on the northwest side of Akutan Island, from the eastward, is seen detached from the point. It is the same height as the point and seems as if part of the point had been detached and slipped a short distance seaward.

Cape Kalekhta, 500 feet high, is the turning point when bound from any of the passes to Dutch Harbor or Iliuliuk. It is a high, rocky promontory separating Unalaska Bay from Kalekhta Bay. The extremity and western side of the cape are rugged, precipitous cliffs, with a few rocks but no beach at the water line. Seen from a distance, its north

end is convex in outline, being steepest at the water and sloping more gently toward the summit. From the summit of the cape, the land falls to the break at Constantine Bay, and then rises to the higher land farther south. While the position of this break can be distinguished, its full extent can be seen only when in Unalaska Bay. From most directions the end of the cape appears as a conical peak. **N. ½ W.** from Cape Kalekhta, distant ⅜ mile, is the outer extremity of a dangerous ledge which is usually well marked by breakers. The cape should be given a berth of 1¼ miles to clear the ledge, as the strong tidal currents may tend to carry a vessel on it.

Priest Rock, close-to off the northwest side of Cape Kalekhta, is a pinnacle about 80 feet high. While classed as a conspicuous landmark, its usefulness to strangers is uncertain. It can only be seen clear of the land when well through Akutan and Unalga passes and when close to the north side of Akutan Island. It shows against the land from all other directions and can not be made out except when close-to. There are similar rocks off several other points in this vicinity, which in thick weather might easily be mistaken by strangers for Priest Rock.

ANCHORAGES.

It is reported that a good anchorage exists under **Cape Khituk** in 7 to 10 fathoms, protected from winds from the westward of south, but no directions can be given.

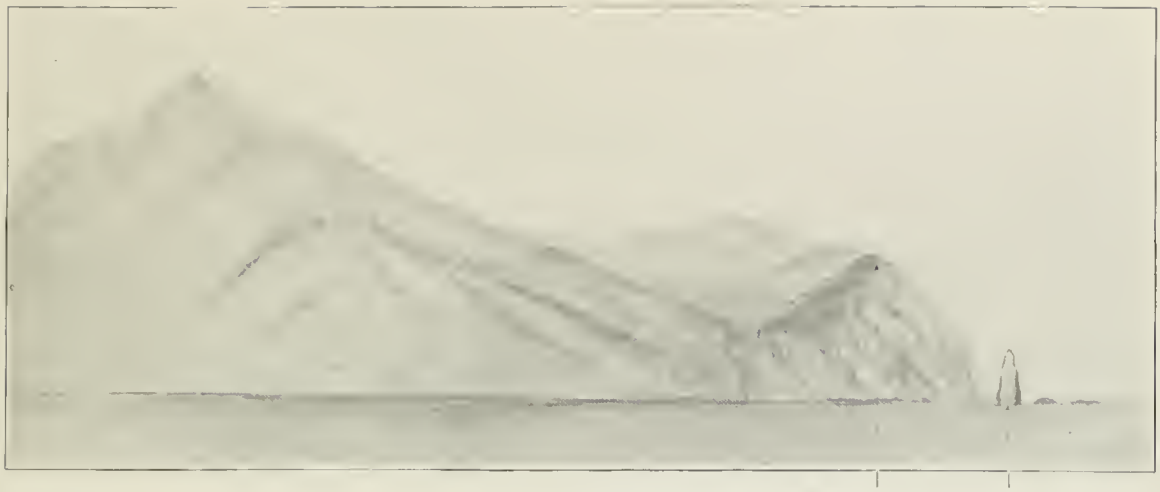
With offshore winds an anchorage can be made close inshore in the **bight** between Cape Saritchey and Cave Point.

Akun Cove is a convenient and safe anchorage except with winds from southeast to northeast, but heavy williwaws are experienced. It is large and easy to approach. The head of the cove is divided into two bights, in either of which a vessel can anchor about ⅓ mile offshore in 7 to 10 fathoms.

Akutan Harbor gives protection from all winds, but the williwaws are violent. The settlement is on the north shore, where there is a depot of the Alaska Commercial Company. The northern side of the entrance to the harbor is a bold, black bluff facing the southeast point of the island. The harbor is about 3 miles in length and ¾ to 1¼ miles in width. The water is deep (20 to 25 fathoms), and the shores are free from outlying rocks except at the bluff at the north side of the entrance, which should be given a berth of at least ¼ mile. To enter, round this bluff at a distance of ½ mile, and proceed up the harbor in mid-channel. Anchor close to the shore abreast the village in 18 fathoms, soft bottom.

UNIMAK PASS.

General directions.—Unimak Pass is the widest of the Fox Islands Passes, being 9 or 10 miles wide in its narrowest part. It is clear of hidden dangers, free from dangerous tide rips, and the tidal current has less velocity than in the other passes. Except near shore, it is free of williwaws. It is the most desirable pass for sailing vessels, and also for all vessels not calling at Unalaska Bay. In approaching from the southward and eastward, care must be taken to keep clear of Sannak Reefs and Anderson and Lenard rocks. A good rule is to make longitude 164° W. while still to the southward of latitude 54° N. and then stand to the northward to make Cape Khituk. If very clear, the mountains of Unimak Island may be made out and the course for Unimak Pass shaped accordingly; but under ordinary conditions the hills back of Cape Khituk, or Ugamok Island, will be the first land sighted. If the weather is thick, soundings on Davidson Bank will be of use in feeling the way in to the land. In the vicinity of Cape Khituk the coast is bold and free from outlying dangers, and may be approached near enough to be seen and the position obtained. A course may then be shaped through the pass, even in the thickest weather, but vessels should first be sure of their position and should not attempt any of the minor passes to the westward of Ugamok Island even in clear weather. A reef of rocks was formerly shown on the chart extending between 1 and 2 miles from the east end of Ugamok Island.



KALEKHTA HEAD, W. ½ S. 5 MILES. PRIEST ROCK.

UNALASKA ISLAND.

PRIEST ROCK, KALEKHTA HEAD, NE. BY E., DISTANT 3 MILES.

AKUTAN PASS.

General directions.—Akutan Pass is about 3 miles wide in its narrowest part. There are four small islets (Gull Rocks) on the western side of the pass, less than ½ mile from Unalga Island, with many detached rocks above water in the same group, but not extending beyond the islets into the pass. There is a reef with some pinnacle rocks on it extending from Cape Morgan not more than ¼ mile into the pass. With these exceptions there are no known dangers. The current and tide rips are not so strong as in Unalga Pass. On this account, and because of its greater width and the fact that a straight course will carry through, this pass is preferred by many to Unalga Pass.

Akutan Pass is recommended for steamers bound to or from Unalaska Bay, and for sailing vessels from Unalaska Bay, having a fair wind. From the southward it is recommended to make the land in the vicinity of Tigalda Island and Avatanak Island and follow along the south side of these islands until the course is shaped from Rootok Island to Cape Morgan. A mid-channel course through the pass is recommended as the most prudent one. From Cape Morgan a **W.** by **S.** course, making allowance for the current, will carry clear of the ledge off Cape Kalekhta. From Unalaska Bay, after clearing Cape Kalekhta, Akutan Pass is open and an **E.** by **N.** course can be steered through.

UNALGA PASS.

Unalga Pass is the small pass between Unalga and Unalaska islands. It is the narrowest and shortest of the three passes, and is more generally used by steamers bound to and from Unalaska Bay than either of the other two. It is about one mile wide in its narrowest part, and, with the exception of rocks above water which make out a short distance from the points of Unalaska Island, the pass is considered free from dangers. In the middle of the pass there are depths of 25 to 35 fathoms, with deeper water northwestward and southeastward. Its worst features are the strong tidal currents and tide rips, both of which are generally considered worse in this pass than in either of the other two; williwaws of great force are also experienced in this pass. The advantage of using this pass in thick weather is that the shore of Unalga Island is clear of dangers, and when made can be followed close enough to keep it in sight while going through. (See Unalga Island, page 18.)

The Signals, Egg Island, and Old Man are the prominent landmarks for making Unalga Pass from the southeastward.

ANCHORAGES.

Beaver Inlet, between Biorka and Unalaska islands, is a deep inlet on the western side of the southern entrance to Unalga Pass. There are several bays leading out of Beaver Inlet. The best anchorage is said to be in Food Bay, on the north side of the inlet, near its entrance. The anchorage near the shore off the village of Biorka, on the south side of the inlet, is poor on account of the deep water; it affords shelter in southerly weather.

English Bay, southwest of Unalga Island, is a good harbor. The water is deep, and there are no dangers except on both sides of the entrance, near the shore. The anchorage is at the head of the bay, in about 10 fathoms.

Kalekhta Bay, eastward of Cape Kalekhta, is clear of dangers except along shore. Anchorage should not be made in less than 10 fathoms. The bay is much smaller in every way than Unalaska Bay, but it is marked by a cascade on its western side not unlike the one recommended as a landmark for Unalaska Bay. There is also a pinnacle rock off Erskine Point, the eastern point at the entrance, somewhat similar to Priest Rock; but this rock is distinguished by a smaller one between it and Erskine Point.

GENERAL DIRECTIONS, UNALGA PASS.

From the southeastward it is recommended to make the land in the vicinity of Tigalda Island and, after fixing the position, shape a course for Egg Island. If the weather is clear and Unalga Island is made out, the course can be shaped for the entrance to the pass; but

if thick, it will be necessary to approach Egg Island close enough to be sure of the position before hauling in for the pass. (See description of the islands on pages 17–18.) It is the general practice to favor the Unalga Island side in going through, because the current seems less strong there and there are no rocks except along the beach. *A straight course will not carry through the pass as indicated on the chart.* When clear of Unalga Island, shape the course to clear Cape Kalekhta 1¼ miles, to avoid the ledge off the cape.

From the southward vessels may pass inside The Signals and Egg Island. The Outer Signals should not be approached too closely, as a sunken rock is reported in its vicinity.

UNALASKA BAY.

Unalaska Bay is the general name of the indentation making in to the north end of Unalaska Island between Cape Kalekhta and Cape Cheerful. Commercially it is the most important bay in western Alaska. Its shores are generally mountainous with precipitous sea faces. Amaknak Island lies in its southern end. Westward of the island the water is deep, but there is no good harbor in this part of the bay; eastward of the island are the important anchorages of Iliuliuk Bay, Dutch Harbor, and Iliuliuk Harbor. The channel to Iliuliuk Bay and Dutch Harbor is free from dangers except along the shores. Iliuliuk Harbor is obstructed at its entrance by ledges.

Cape Kalekhta and **Priest Rock.** (See pages 19–20.)

Cape Cheerful, the western point at the entrance to Unalaska Bay, is made up of bold, very high headlands, rounded on top, and intersected by deep, grassy valleys. The shore is free from dangers and has deep water close-to. A cascade, 125 feet high, south of Cape Cheerful, is a conspicuous mark from the vicinity of Cape Kalekhta, and is useful in thick weather when only the lower part of the land can be seen.

Ulakhta Head, 900 feet high, the north end of Amaknak Island, is, in clear weather, one of the best landmarks for fixing the position of Unalaska Bay. In appearance it is like a pyramid with the top cut off. The top shows perfectly flat, and there is no other headland or mountain in this vicinity that has this feature. It is not as high as the background, but shows up well against it, and can be made out at a long distance from the bay. From its northwest point a reef extends off ½ mile, marked by Needle Rock, similar in appearance to Priest Rock, but not so large. From its northeast point a long, narrow sand spit extends to the southward 1½ miles; its southern end, called Spithead, is marked by a beacon, about 15 feet high, standing close to its southern shore.

Princess Head, 2 miles from Cape Kalekhta, is a large square-headed rock that projects from the shore far enough to be distinctly observed, even in thick weather, in following along the east shore.

Constantine Bay, about 4 miles from Cape Kalekhta, is obstructed by numerous rocky ledges, many of which are only evident from the attached kelp. It is of no importance and should be avoided by all vessels.

Summer Bay, the large, shallow bight, 3 miles from Constantine Bay and opposite Ulakhta Head, is shoal, and its shores are lined with kelp-marked rocks and ledges. At its southern headland is Pinnacle Rock, about 60 feet high. This bay is an excellent place to seine for salmon. The bay should be avoided by vessels.

Iliuliuk Bay extends from Pinnacle Rock and Ulakhta Head to Iliuliuk. To the northward of Spithead there is a ridge extending across the bay, having a least depth of 10 fathoms. South of this ridge the depths increase to 16 and 19 fathoms. There is anchorage anywhere in the bay. The usual anchorage is at the head in 14 to 16 fathoms, muddy bottom, where, even with northerly winds, the force of the sea does not seem to reach home. At the head of Iliuliuk Bay, behind the village, there is a distinct ravine or break in the mountains, which extends through to the water to the southward. This is a useful guide for entering the bay and inner harbor.

DUTCH HARBOR is on the west side of Iliuliuk Bay. Its entrance is between Spithead and Rocky Point. The water is deep close to the shores, and in all parts of the harbor, except off Rocky Point, where there is a reef making off a little less than ¼ mile, marked at its end by a buoy. The entrance between Spithead and the end of the reef off Rocky Point is about ½ mile wide, with a depth of 18 fathoms. Anchorage may be had throughout the harbor in from 14 to 19 fathoms. Violent williwaws are experienced, with strong winds.

The headquarters of the North American Commercial Company for this part of Alaska are situated on the south side of Dutch Harbor. In front of their warehouses and coal depot an L-shaped wharf extends out to deep water. Large ships can lie at the outer end, which is about 200 feet long, and there is ample room for small vessels on the inside of the L. The post office of Udakta is now established at Dutch Harbor.

Supplies.—There is a stock of several thousand tons of coal carried by the company, which can be obtained, delivered on the wharf, at from $10 to $12 per ton, at the rate of from 150 to 250 tons per day. Fresh water can be obtained from a hydrant on the wharf at ½ cent per gallon.

The company's store carries a supply of ship chandlery and outfits, and is well stocked with canned goods and salt provisions. Fresh meats and provisions can be obtained at times.

There is a small machine shop and blacksmith shop, where light work can be done by the vessel.

ILIULIUK HARBOR is joined to the head of Iliuliuk Bay by the passage between Iliuliuk Reef and the village of Iliuliuk (Unalaska).

Channels.—The channel generally used is the one to the southward of Iliuliuk Reef, on either side of Tuscarora Rock, and has a least depth of about 5 fathoms. There is a channel north of Iliuliuk Reef, between it and North Rock, which has a least depth of 3¼ fathoms, but should not be attempted except with local knowledge.

Anchorage.—Iliuliuk Harbor is small, perfectly landlocked, with good holding ground, and an average depth of 10 fathoms. The headquarters of the Alaska Commercial Company are at Iliuliuk, and the company has a wharf projecting into the harbor from the western end of the spit on which the village is located.

Iliuliuk is the original Russian settlement. There is a Greek church here with a parochial school, also a Methodist mission school. The post office, United States deputy collector, and United States commissioner for this general locality are located here. The post office is called Ounalaska.

Supplies, etc.—The Alaska Commercial Company has a well-stocked general store and very commodious warehouses for its own use at Iliuliuk. There is a limited amount of coal kept on hand which is usually not for sale; a coaling station is contemplated at this point. Fresh water can be obtained at the wharf, and boats can water on Amaknak Island, opposite the wharf.

Tides.—See tide table, pages 10–11.

The **tidal current** in Dutch Harbor is inappreciable, and in Iliuliuk Harbor does not exceed one knot.

Ice.—The bay is open to navigation at all seasons. It is reported that on two occasions the drift ice of Bering Sea entered Unalaska Bay, but such occurrences are very rare and need not be considered. Ice often forms in the sheltered coves and harbors in cold, calm weather, but it never attains any thickness or interferes with navigation.

SAILING DIRECTIONS, UNALASKA BAY.

General directions for approaching and entering.—When bound for Unalaska Bay from any part of Bering Sea, it is recommended to shape the course for Cape Cheerful. In thick weather it is better to fall to the westward of Cape Cheerful and then round it than to fall to the eastward of it and get down among the passes. **Makushin Volcano,** 5,174 feet high, can generally be seen in clear weather, and is very prominent. An extinct **crater,**

2,314 feet high, back of Cape Cheerful and west of Eider Point, gives a distinct point for which to steer until close enough to distinguish the surrounding features. On getting close to the island, when the fog hangs over the land but leaves a clear space just along the water's edge, **Wislow Island** forms a good landmark. It is a very small, rounded island, regular in shape, and stands off far enough from the land to be distinctly seen as not a part of the main island. To the westward, under similar conditions, **Makushin Cape** can be seen at times. The land slopes gently to the cape from Makushin Volcano, and ends in a small, peak-like formation at the end of the cape. From the eastward the **cascade** south of Cape Cheerful is also useful. Strangers, when in the vicinity and uncertain of the identity of the bay and its landmarks, should endeavor to pick out **Ulakhta Head.** Looking into the bay, its flat top breaking off abruptly to sloping sides presents an appearance unlike any other in the vicinity, and shows up well against the background of mountains. When sighted, steer for it, leave it on the starboard hand, and follow around, keeping out of kelp.

Cape Kalekhta to anchorage.—Having arrived in the vicinity of Cape Kalekhta, bring it to bear **ESE.**, distant 1¼ miles, and steer **S. ½ W.** This course made good for about 7 miles leads to a position in line between Pinnacle Rock and Ulakhta Head, slightly nearer the former. Then change course to **SSW. ½ W.**, heading for the ravine back of the village at the head of Iliuliuk Bay, and anchor near the head of the bay, in 14 to 16 fathoms.

If desiring to enter Dutch Harbor, on the **SSW. ½ W.** course, when Spithead bears abeam, change course to **WSW. ½ W.**, and anchor in the harbor as desired.

If desiring to enter Iliuliuk Harbor, continue the **SSW. ½ W.** course until the buoy or kelp marking Tuscarora Rock is sighted. Then haul to the westward and pass the rock close-to on either side, keeping out of the kelp. Both Tuscarora Rock and Iliuliuk Reef are well marked by kelp, which serves as a guide if the buoys are not in place. When clear of the kelp on Tuscarora Rock haul to the northward to pass in mid-channel between the western dry rocks of Iliuliuk Reef and the shore to the southward; then steer to enter the harbor in mid-channel. Anchor in the middle of the harbor in 10 fathoms. Or in entering the harbor the north side may be favored, if desired, to allow room for turning to go to the wharf.

Remarks.—On the **S. ½ W.** course the shore to the northward of Constantine Bay is passed at a least distance of ⅜ mile. In thick weather, when following along the east shore, care must be taken not to enter Constantine or Summer bay by mistake. This has sometimes occurred when the opposite headland could not be made out. In passing to the southward of Tuscarora Rock, vessels are obliged to make a very sharp turn to the westward, and care must be taken to keep off the beach.

DANGERS.—Navigators should avoid the kelp, which invariably indicates a rocky bottom.

A large cluster of rocks, mostly awash, and usually marked by breakers, extends nearly 200 yards to the westward of the south head of **Constantine Bay.**

Pinnacle Rock is surrounded by reefs, awash and under water, for a distance of 300 yards. Between Pinnacle Rock and a point opposite the entrance to Dutch Harbor the east shore is lined with rocks, and should not be approached closer than ¼ mile.

The **spit** has a kelp-marked shoal on its east side which extends its whole length; at its middle point the shoal extends ¼ mile from shore. Spithead is bold-to, and may be safely approached as close as 150 yards. There is a beacon, about 15 feet high, standing close to its southern shore.

Rocky Point has a kelp-marked reef which extends toward Spithead about 350 yards; eastward of the point shoal water makes out about 200 yards with little kelp. The northern extremity of the reef is marked by a buoy painted white.

From Rocky Point south, the shore of Amaknak Island should not be approached closer than 300 yards.

Iliuliuk Reef consists of a ledge of rocks, portions of which are always exposed, extending in an east and west direction for 250 yards. From the eastern dry rock a

2¼-fathom ledge, marked by kelp, extends **S.** by **E.** ¾ **E.** 150 yards. The southern extremity of this ledge is sometimes marked by a buoy.

Tuscarora Rock is a 3¼-fathom spot, marked by kelp, which lies about 50 yards **SSE.** ½ **E.** from the southern extremity of Iliuliuk Reef. It is small and generally marked by an iron barrel buoy. These buoys are maintained by the Alaska Commercial Company, and may be followed if in place.

BRISTOL BAY.*

Bristol Bay may be said to include all that part of Bering Sea lying east of a line drawn from Cape Saritchey (Northwest Cape), Unimak Island, to the Kuskokwim River. Unimak Island and the Alaska Peninsula bound it on the south and east, and separate it from the Pacific Ocean. The Naknek River is at the head of deep-water navigation, while the bay itself terminates in the Kvichak River, a few miles northward. The region about the Nushagak River, Kululak Bay, and the Kuskokwim forms its northwest boundary.

The shore lines are usually low and without distinctive features, but high mountain ranges and volcanic cones extend along the central parts of Unimak Island and the Alaska Peninsula. These rugged snow-covered mountains and lofty peaks would serve as unmistakable landmarks were they not obscured by the almost constant fogs which prevail in that region during the summer months. In fact, they were so seldom visible during the season of 1890 that the officers of the *Albatross* made no pretense of using them as landmarks. The shore line and objects near the sea level were often seen beneath the fog when the higher lands were obscured, and, therefore, most of the available landmarks were found on or near the beach.

THE COAST FROM UNIMAK PASS TO PORT MOLLER.

Cape Saritchey (Northwest Cape), Unimak Island, is low with detached rocks, around which strong tidal currents sweep. The land falls away eastward in a gentle curve, forming an open bay about 4 miles in depth between the cape and Cave Point, which lies **NNE.** ½ **E.,** 16 miles from the former. **Cave Point** is a vertical rocky cliff, about 150 feet in height, and takes its name from a cave on its face, inhabited by sea birds, which in summer time hover about it in thousands, making it conspicuous in clear weather by their numbers, and in fogs by their constant cries. The snow-clad peak of **Pogrumnoi Volcano,** rising to an altitude of 5,523 feet above the sea, forms a striking background to the low, monotonous coast.

Passing **Cape Lapin,** a low bluff point about 8 miles from Cave Point, the coast falls away slightly for 6 miles, when it turns abruptly to the eastward for 5 miles, and then takes a northerly direction, forming **Shaw Bay.** This bay is open to the northward, but affords protection from all winds from the southward of east or west. The approaches are clear, and the water shoals gradually to 6 fathoms, black sand, about ¾ mile from shore.

From Shaw Bay to Isanotski Strait the coast trends in a northeasterly direction, is very low and has several rocky patches extending from ½ to 1 mile from shore, making navigation unsafe inside the 12-fathom line. The volcano of **Shishaldin** rises 8,953 feet about midway between the above points and 7 or 8 miles inland. Isanotski Strait is available only for vessels of the smallest class.

From the strait to **Cape Glasenap,** about 19 miles, the coast line retains the same general direction and is very low until reaching the latter point, which is oval in form, about 150 feet in height, and has been called Round Point.

Izenbek Bay covers a large area at high tide, but much of it becomes dry at low water. A small vessel may, however, find a secure harbor behind the cape. The channel follows close around the point, and has a depth of 10 to 12 feet on the bar.

* From a reconnoisance by Lieut. Commander Z. L. Tanner, U. S. N., commanding U. S. S. *Albatross*, in 1890.

Amak Island is of volcanic origin, about 2½ miles in length, 1½ miles in width, and 1,682 feet in height. It lies 11 miles northwest from Cape Glasenap. The beaches are mostly of huge water-worn bowlders, having vertical bluffs from 30 to 150 feet in height, with moss-covered plateaus, which in summer time are covered with a rank growth of grass and wild flowers. The central peak is of dark-brown rock, exceedingly rugged and precipitous, and entirely devoid of vegetation. The southeast point was found to be in latitude 55° 25′ 05.6″ N. and longitude 163° 07′ 33.6″ W. There is foul ground off the northwest extremity of the island, several rocks awash or under water, and Sea Lion Rock lying between 2 and 3 miles distant. The latter is several hundred yards in extent and about 150 feet high, its slopes being occupied by an extensive rookery of sea lions.

The **Khudiakof Islands** extend about 19 miles **NNE.** ½ **E.**, between Cape Glasenap and Neumann (Moffett) Point. They are but little above high water, and some of them are connected by narrow spits when the tide is out.

From Neumann (Moffett) Point the low coast trends north by east 15 miles to Gerstle Bay, then to the northward and eastward about 55 miles to Wolf Point, on the western side of the entrance to Port Moller.

The **Khudubin Islands** occupy the last 23 miles of this distance. They are very low, and it is difficult to distinguish them from the mainland, the only distinctive feature being a knob about 25 feet high on the east end of Kritskoi. The land between Herendeen Bay and Nelson Lagoon is very low.

PORT MOLLER, HERENDEEN BAY, AND VICINITY.

Port Moller and Herendeen Bay had no commercial importance until the recent opening of a coal mine* in the latter, which has drawn attention to this almost unknown region. The *Albatross* visited the mine twice during the season of 1890, and made a survey which was found to be sufficiently accurate for purposes of navigation. The chart should be used with caution, however, until it is ascertained whether the extensive banks guarding the entrance are permanent or shifting.

To enter Port Moller from the southward, pass Walrus Island in from 10 to 12 fathoms, and bring **Entrance Point,** the eastern point of entrance to Port Moller, to bear **ESE.** It will then be about 8 miles distant, and have the appearance of being the southern extremity of a high and bold headland, the first that approaches the coast between that point and Cape Glasenap. Stand in, keeping the point on the above bearing until within 2 or 3 miles, when it will show as a low spit backed by a cluster of hillocks, the high land before referred to being seen farther inland. Pass Entrance Point at a distance of 1 mile, steering about **SSE.** ½ **E.**, and stand for **Harbor Point,** 4½ miles **S.** by **E.** from Entrance Point, passing it within ¼ of a mile, where anchorage may be found. The point is low.

A shoal makes off from Entrance Point about **NW.** by **N.** between 3 and 4 miles, and vessels making for the harbor *from the northward* are liable to run in behind it. Entrance Point should not be brought to bear to the southward of southeast after having approached within 4 miles of it.

To enter Herendeen Bay, bring Entrance Point to bear **NE.** ½ **E.**, 1 mile distant, and **Point Divide SSW.** ⅜ **W.**, 8¾ miles distant; then steer for the latter, keeping it on that bearing until within 2½ miles, when the course may be changed to about **SW.** ¾ **S.**, passing in mid-channel between Point Divide and **Doe Point,** the southeast point of Deer Island. The least water is 4 fathoms at the entrance to the channel.

Having cleared Hague Channel, bring **Coal Bluff,** 5 miles **SSE.** from Point Divide, to bear **SE.** ¼ **S.**, and stand for it until Point Divide bears **N.** by **W.** ½ **W.**, 1½ miles distant and about 400 yards open of Doe Point; then steer **SSE.** ¾ **E.**, until **Eagle Rock,** 1 mile **NNW.** from Coal Bluff, is abeam, keeping the above points a little open to clear **Half Tide Rock,** which lies **NW.** by **W.** ½ **W.**, ⅞ mile from Eagle Rock. Then steer

*Since abandoned.

S. by **E.** ¼ **E.** until **Shingle Point,** 2 miles **SSE.** from Coal Bluff, is abeam, when a course may be laid for Mine Harbor, giving Bluff Point a berth of ¼ mile.

Mine Harbor is small but free from dangers, except Midway Reef, which shows at half tide. Anchor in from 12 to 15 fathoms, and if a vessel intends to remain any time it is advisable to moor.

Tides.—It is high water in Mine Harbor, full and change, at 8h. 0m., rise 15 feet, and it occurs at Entrance Point about 2 hours earlier, with a rise of 10 to 12 feet.

Hague Channel is 1 mile in width at its northern entrance, and is contracted to less than ½ mile between Point Divide and Doe Point. The tidal streams are very strong, and near high water they sweep across the narrow channel and over the flats, making it impossible to steer a compass course. They are more regular near low tide, which is the best time to make the passage, as the channel is indicated by the flats showing above water on either hand.

Johnston Channel, Herendeen Bay, has from 7 to 15 fathoms of water, but is very narrow with steep sides. It is difficult to find, but once in, the navigation is comparatively simple, as the tidal currents follow the general direction of deep water. The width of the channel at the northern entrance, ⅝ mile south of Point Divide, is ¼ mile, with little variation until near the southern extremity, where it contracts to 250 yards. Having cleared the channel and entered the upper bay, there is ample room and depth of water in every direction, Crow Reef, off the south point of Mine Harbor, being the only outlying danger.

Anchorages may be found anywhere between Walrus Island and Entrance Point in case of fog, and a vessel may anchor in Hague Channel, but the tidal currents are strong. There are fairly good anchorages under the north side of Point Divide and Doe Point, where, near the bank, a vessel will be out of the strength of the current. The *Albatross* anchored in mid-channel, 1 mile inside of the above points, at the time of spring tides, and the flood came in with a bore between 2 and 3 feet in height, the patent log registering a 9-knot current for some time, with a swell which occasionally splashed into the scuppers. There is a fair anchorage off the northern entrance to Johnston Channel, and an excellent one at its southern extremity, off Marble Point, just north of Shingle Point, or, in fact, almost anywhere in the upper bay. The last quarter of the flood tide is the best time to pass through this channel.

High land rises at the base of Harbor Point, and extends to the northward and eastward near the center of the peninsula. Point Divide is 50 feet in height, and mountain ranges rise a few miles back. The coal measures are found between Mine Harbor and the head of Port Moller. Doe Point is 40 feet in height, while the rest of Deer Island and the mainland south and west of it is generally lower. The southern shores of Herendeen Bay are mountainous, with intervening valleys, the whole face of the country being covered with rank grass and wild flowers during the summer months; but there is no timber, except occasional small poplars, alder bushes, and willows. Fresh winds, with fog and mist, blow across the low divides from the Pacific, obscuring the sun and greatly increasing the rainfall in Port Moller and vicinity.

The region is uninhabited, except by men employed at the coal mine; bear and reindeer were plentiful, and the waters teemed with salmon. There are no large fresh-water streams entering the bay, however, which probably accounts for the absence of Eskimos. The coal mine * in Herendeen Bay lies 1¼ miles from the landing in Mine Harbor.

THE COAST FROM PORT MOLLER TO THE KUSKOKWIM RIVER.

The coast is low for 19 miles between Entrance Point and **Cape Kutuzof,** which rises in a rounded bluff to an elevation of 150 feet.

Cape Seniavine, 11 miles to the northward and eastward, is a rocky point 75 feet high. Passing it, the low monotonous beach continues to the Seal Islands, the only exception being a cluster of small hillocks near the beach, 12 miles from Cape Seniavine.

* Now abandoned.

The **Seal Islands** are composed of several small islets, but little above high water, strung along near the coast for about 10 miles; thence to Strogonof Point the land continues very low.

Port Haiden is said to be a good harbor, but we did not examine it. Should a survey show it to be safe and easy of approach, it will prove a great convenience to vessels employed on the northern part of Baird Bank. The approach to Port Haiden will be recognized by high, bold headlands, which rise from its northern shore.

Chestakof Island, low and crescent-shaped, forms the seaward side of the harbor, the channel lying between its northern extremity and a reef which makes out from the land. The same low coast extends to Cape Menchikof in nearly a direct line, the highland of Port Haiden gradually receding from the coast.

The Ugashik River lies northward of Cape Menchikof, and has been reported navigable for several miles by vessels of 14 feet draft. The schooner *Pearl* enters the river, but her captain reports a wide bar having intricate channels, strong currents, and usually a heavy swell. Ten feet is about all that can be carried in with safety. Once inside, it is reported to be a good harbor, but it can hardly be considered available for the ordinary purposes of fishing vessels. Mr. Hale, superintendent of canneries, reports that a draft of 16 to 18 feet can be taken over the bar into Ugashik River.

Cape Greig, a bluff 243 feet in height, and a peculiar notched mountain some distance inland, are good landmarks for the river. The low coast continues from the cape to the Ugaguk River, and thence to the Naknek River, with hardly a distinguishing feature, except Johnstons Hill, a solitary elevation, 5 miles from the beach and about 9 miles **S. ½ E.** from the mouth of the Naknek. The coast sweeps in a graceful curve to the northward between Cape Greig and the Ugaguk, and thence to the eastward to the Naknek River. A gravel bank lines the coast in several places, behind which a narrow strip of water is seen, particularly at or near high tide.

The **Naknek River** may be considered as the head of deep-water navigation in Bristol Bay. The *Albatross* found anchorage in 6 fathoms about 6 miles **SW.** from Cape Suworof, the water shoaling rapidly to 3 fathoms toward the head of the bay. Vessels of moderate draft can pass the bar at high water, but there is hardly depth enough to float a ship's boat when the tide is out. It is deeper inside, however, and a small vessel may find anchorage with swinging room. There is a fishing station on the river, which is visited periodically by a small steam tender. The South Head is in latitude 58° 42′ 04.3″ N. and longitude 157° 02′ 45.4″ W.; high water, full and change, 1h. 5m.; rise, 23 feet. Shoal ground makes off from the west shore, confining the channel in one place to about 3 miles in width. It may possibly be a middle ground, with a channel on either side, but the conditions off Etolin Point seem to disprove this.

NUSHAGAK RIVER.

The Nushagak River is assuming considerable importance as the location of a trading station and of a number of large well-equipped salmon-canning establishments. Protection Point, the entrance to the river, is 50 miles **SW.** by **W.** from the Naknek River, and, owing to swift currents and extensive shoals, it may be classed among the most intricate pieces of navigation in Bristol Bay. A 6-knot current is frequently encountered, hence the shifting of banks and shoals must be expected, and the necessity for the constant use of the hand lead becomes too obvious to require remark; indeed the warning from a lead on each side will leave but a small margin of safety at times. The land on both sides of the entrance is very low, and it is difficult to recognize Etolin Point even under favorable conditions. A vessel from the westward would make the Walrus Group and follow the coast to Cape Constantine, and, having cleared the outlying shoals, stand in for Protection Point, which is difficult of recognition from a distance.

Nichols Hills, 280 feet in height, are a cluster of rounded elevations 5 miles northwest of Protection Point, and are the first natural objects distinguishable on the peninsula.

Bring them to bear **WNW.** and stand in, keeping them on that bearing until Protection Point bears about south, and anchor, making due allowance for falling tide.

There is a **pilot** station on the point, with a small flagstaff, on which a flag will be hoisted if the pilot is at home. He is an Eskimo, and speaks very little English, but he knows the channel. If he is not at the point when the vessel arrives, he will probably be at Ekuk, and may be expected on board within a few hours if the weather is not too rough for his kayak. A stranger should not attempt to enter without a pilot, unless from necessity.

Clarks Point is 18 miles **N.** by **W.** from Protection Point, the usual anchorage being from ½ mile to 1 mile above it.

Ekuk, an Eskimo village, is on the bluff nearly 3 miles below Clarks Point.

Clarks Point is a bluff 200 feet in height, beginning below Ekuk and extending 2 or 3 miles up the river, and thence to Nushagak. It varies from 100 to 150 feet in height. The west side is generally lower, but from Coffee Point, 4 miles **NW.** from Clarks Point, to the northward the bluffs rise from 50 to 200 feet.

Clarks Point (foot of bluff), is in latitude 58° 49′ 14″ N. and longitude 158° 31′ 43.9″ W. High water, full and change, 0h. 53m., approximate; rise, 24 feet.

The reconnoissance of the Lower Nushagak was made during the few days we were detained in the river. The principal points are located by triangulation; Clarks Point by astronomical observations, and the reduction of soundings to low water depends upon the tides during our stay. It is to be regretted that we were unable to extend the soundings to the west shore.

The Nushagak Packing Company have a cannery at Clarks Point, and there are three others, besides a trading station, in the river, the latter at Nushagak, formerly called Fort Alexander. Vessels of moderate draft can reach the canneries, and with a little care find anchorage with sufficient water even during the lowest tides. The timber line is well defined about 3 miles below the mouth of Wood River, and extends to the westward as far as the eye can reach. The weather was pleasant during our stay, and from all reports they have less fog in the Nushagak than in any other part of Bering Sea.

Mr. Hale, superintendent of canneries, states that vessels of 21 feet draft enter the Nushagak River to Clarks Point; that the channel between Cape Constantine and Point Etolin, though tortuous and requiring a good pilot, affords plenty of water; and that sailing vessels require a tug in entering and leaving. The rise and fall of the tides in the river is 28 feet, leaving sufficient water in the channel, at mean low water, for deep draft vessels.

Cape Constantine, the southeast extremity of land at the entrance to the Nushagak, is very low, and shoals extend 10 or 12 miles southward and eastward, making its approach in thick weather very dangerous. There is said to be a channel between the cape and the first shoal, but the report requires verification. The coast line increases in height westward of the cape, the headlands in Kululak and Togiak bays reaching an altitude of 500 feet or more.

The **Walrus Group** is composed of three islands and three rocks, all above water, extending 16 miles east and west and about 6 miles north and south.

Round Island, the easternmost of the group, lies **W. ½ S.,** 36 miles from Cape Constantine. It is nearly 2 miles in length, ¾ mile wide, and about 800 feet high, its west end being in latitude 58° 36′ 09″ N., longitude 159° 57′ 51.7″ W.

Crooked Island is between 4 and 5 miles in length and 2 miles in greatest width. The eastern part is rather low, but toward the western extremity the elevation is nearly equal to that of Round Island. There is quite a large bay on the northeast side, but we did not examine it.

High Island, the westernmost of the group, is 4 miles in length, about 1 mile in width, and 900 feet or more in height.

The Twins are two isolated rocks 4 miles to the southward of Crooked Island, the larger 300 and the smaller 100 feet in height.

Black Rock, about 150 feet high, lies 1 mile northward of the south end of Crooked Island.

No other outlying dangers were seen in passing between the islands and the mainland. From 6 to 10 fathoms were found abreast the group, the depth gradually decreasing to 3 fathoms off the north end of Hagemeister Island. We were near the shore, however, and would doubtless have found more water in mid-channel.

Hagemeister Island lies 9 miles west of High Island, and is 14 miles in length and 8 in width. It is mountainous except for about 5 miles at the north end. Shoal ground surrounds the island and extends from 20 to 25 miles to the eastward, including the area between Hagemeister and the Walrus Group.

Hagemeister Channel is about 16 miles in length and lies between the island of that name and the mainland. It is from 3 to 4 miles in width, but shingle spits contract it in two places to less than 2 miles. The least water was 4½ fathoms. Good anchorage was found under Tongue Point, the shingle spit making out from the mainland about midway of the channel. From the above anchorage the *Albatross* stood directly to sea, passing within a mile of the southwestern extremity of Hagemeister Island; thence **S. ½ W.**, shoaling the water to 3 fathoms 7 miles from the island. Greater depths might possibly be found by taking a more westerly course. The tidal currents are very strong through the channel. We were visited by a number of Eskimos while at anchor under Tongue Point.

Cape Peirce is of moderate height and symmetrical form. Depths of 10 fathoms are found 2 miles to the southward of the cape, and good anchorage in 10 fathoms of water is found inside Seal Island (the island lying just to the eastward of the cape).

Cape Newenham is a high, bold, headland, with sharp peaks and rugged lines. In 1899 the U. S. S. *Corwin* passed within 2 miles to the westward of Cape Newenham and carried 4 to 5 fathoms of water. While following the land at a distance of 2 miles, and keeping out of the indentations between Cape Newenham and Goodnews Bay, the depths were 3½ to 4 fathoms until within 2 miles of the entrance to the bay, where the water shoals abruptly. The *Albatross* found anchorage under the latter cape near Seal Rock during a southerly gale, and laid it out very comfortably, notwithstanding swift currents and heavy tide rips.

The **Kuskokwim River** is much dreaded by navigators on account of its extensive shoals, strong currents, etc. The *Albatross* ascended it between 35 and 40 miles without difficulty or delay, but encountered extensive shoals on her return. Thick weather and the lack of time prevented an extended examination. They commenced about 9 miles **WSW.** from Goodnews Bay and extended in a westerly direction for 10 miles or more. There is a channel between the shoal and the land about 4 miles wide, having a depth of 5 fathoms. From a point 5 miles **WSW.** from the west head of Goodnews Bay we stood direct for Cape Newenham, the least depth being 4 fathoms. Great quantities of fresh water are borne down the Kuskokwim by the rapid currents, and, while there have been no surveys by which changes can be noted, there seems no reasonable doubt that great alterations have taken place since Cook ascended the river in the last century.

METEOROLOGICAL CONDITIONS OF BRISTOL BAY.

The winds and weather in Bristol Bay and the other parts of Bering Sea visited by the *Albatross* from the last of May to the 1st of September, 1890, may be summarized in a few words.

Southwest winds prevailed, but we had them frequently from southeast to northwest. It was boisterous weather nearly half the time, but seldom rough enough to interfere with our work. We had several summer gales of moderate force, but no severe storms. Fog and mist prevailed, and a clear day was the rare exception. The tidal currents were strongest in the vicinity of Unimak Pass and at the head of the bay; they were greatly affected, however, by the winds. The flood stream set to the northward and slightly inshore along the coasts of Unimak Island and the peninsula, the ebb to the southward and offshore.

The former was invariably the stronger, and probably found an outlet by sweeping past Cape Constantine in the direction of Cape Newenham. There has been no systematic study of the currents of Bering Sea, and the almost constant fogs prevent the navigator from adding much to our meager knowledge concerning them.

PRIBILOF ISLANDS.

This group consists of St. Paul, St. George, Otter, and Walrus islands. The two latter are small and uninhabited. St. Paul and St. George are important as containing the largest and most numerous seal rookeries of the world. These two islands are each in charge of a United States Government agent, and are at present under lease to the North American Commercial Company. Excepting vessels of the United States Government and those in the employ of the company, all vessels are forbidden landing on these islands. There are no harbors about the islands, and the anchorages are only available with the wind off the land. Because of the uncertain and shifting nature of the wind in this locality, vessels should always anchor with a view of getting under way quickly if necessary.

Fogs are especially thick and prevalent in this vicinity in the summer, and navigation is attended with difficulty and danger.

These islands are at about the southern limit of the ice in Bering Sea. Detached fields of ice will generally be found in their vicinity from February to May.

ST. GEORGE ISLAND.

St. George Island consists mainly of high volcanic hills and ridges, and its entire shore is a precipitous cliff except for a few miles on the north side and short intervals at Garden Cove and Zapadni Bay. The east and west extremities of the island, Tolstoi and Dalnoi points, are both bold promontories.

High Bluff, on the north side of the island, 1,012 feet high, is a prominent landmark, and is plainly visible from St. Paul Island, a distance of nearly 40 miles, on a clear day. There are no harbors, but vessels anchor at North Anchorage, Garden Cove, and Zapadni Bay, according to the direction of the wind; the anchorages are poor except with the wind directly off the land. At a distance generally not greater than 2 miles from the island the depth of water is but little less than the surrounding sea, and in thick weather it is not safe to depend upon soundings for picking up the land unless sure of the position. Vessels should not approach the island in less than 12 fathoms of water. There are no outlying dangers except the small reefs at Zapadni Bay and at North Anchorage. It is reported that vessels have found breakers, in very heavy weather, about 9 miles east of Tolstoi Point.

Anchorages.—The anchorage in **Zapadni Bay,** on the southwest side of the island, in 10 fathoms of water, affords good shelter with winds from east-northeast to north-northwest. The landing is on the open sand beach, and can usually be made with northerly winds. A reef extends about ¼ mile offshore to the southward of the anchorage.

With northerly winds, a landing may sometimes be made at **Garden Cove,** on the sand beach. The anchorage affords good shelter from northwesterly winds, but with the exception of a small area the bottom is rocky.

At **North Anchorage** there are two houses on the beach, with a road back of them leading up the hill to the village. In approaching, get these two houses open and steer for them. Anchor in not less than 10 fathoms. A flag is shown from the flagstaff when landing is possible. The landing westward of the houses is a cutting in the rocks for small boats to enter at high or medium tides. It is somewhat protected by a ledge of rocks north of it, and by kelp, which tends to reduce the breakers. At East Landing, just northeast of the village, is a similar boat landing, but better protected from a westerly swell. A ledge of rocks awash lies a short distance off this landing.

Tidal Currents.—The current sets eastward during the rising tide and westward during the falling tide, with a maximum velocity of 2½ knots. With opposing wind and

current, tide rips occur off Tolstoi and Dalnoi points. These rips are not heavy enough to be of any moment, except that to strangers they may appear to be breakers. The water off both points is deep and they can be passed close-to with safety.

OTTER ISLAND.

Otter Island has an abrupt bluff at its southwest end, 288 feet high, sloping gradually to the north and rising again in a crater, 150 feet high, at its extreme east end. Foul ground, marked by kelp, extends about ¾ mile from the island on its south, southwest, and north sides. The north side, from Crater Point to Northwest Reef, is clear of dangers. Probably the best anchorage near the island is in 9½ fathoms, black sand and broken shells, with the northeast extremity of Crater Point bearing **S.** by **E.**, distant ½ mile. This island must be approached with great caution in thick weather, and at all times keep out of kelp. Between Otter Island and Reef Point, St. Paul Island, the tidal currents are strong, and with heavy winds dangerous tide rips occur.

WALRUS ISLAND.

Walrus Island is low, about 15 or 20 feet above the water, level on top, and composed of irregular masses of volcanic rock. It is about ⅜ mile long and ⅛ mile wide. Anchorage can be had on either side of it, ¼ to ½ mile offshore, in 10 to 15 fathoms. Landing can be made with smooth water, the best place for this purpose being in a small cove at the southwest corner. The island is a bad place to make in a fog.

Parts of Otter and Walrus islands are covered with sea birds in the breeding season, and at the proper time a plentiful supply of eggs may be obtained.

ST. PAUL ISLAND.

The west and southwest sides of St. Paul Island are high and mountainous, with precipitous cliffs at the shore line. The rest of the island is a comparatively low, rolling plateau, with a number of extinct volcanic peaks scattered over its surface. Bogoslof, 590 feet high, a conical crater near the center of the Island, and Polovina, a double-peaked hill near its east end, are very conspicuous, and are the best landmarks in clear weather when coming from the southward. From this hill the island stretches away in a low, narrow neck to Hutchinson Hill, on Northeast Point. West of Lukanin Bay the shore of the south side of the island is rocky, with bluffs at the points. The shore of the rest of the island is generally a sand beach, with rocks in the vicinity of the seal rookeries.

Dangers.—The north shore from Cross Hill to Southwest Point is free of dangers, no reefs or rocks up to within ½ mile of land, except off North Hill; but the bottom is uneven and rocky and the anchorage not generally good.

Breakers extend off **Southwest Point** a distance of ½ mile or more.

A dangerous ledge of rocks, usually marked by breakers, extends off **Reef Point** fully ½ mile.

A reef extends off **Stony Point** about ¼ mile.

The rocks off **Sea Lion Neck** should be given a berth of at least 1 mile. The dangerous reef north of Hutchinson Hill, the northeast point of the island, consists of two rocks marked by kelp. There are 3½ fathoms on the outer rock and 3 fathoms on the inner. The outer kelp patch is a little less than 1 mile **N.** by **W.** ½ **W.** from Hutchinson Hill. There are depths of 4, 5, and 6½ fathoms close in to the shore, with 7½, 9, and 13 fathoms midway between the rocks and the shore. With a moderate swell the sea breaks over these rocks and for a short distance off Northeast Point.

Off **North Hill** a shoal extends about ¼ mile northward, the depths gradually increasing to 4, 5, and 6½ fathoms at the distance of 1 mile from the shore. A rocky patch, with 7 fathoms water on it and 9 to 13 fathoms around, lies with Hutchinson Hill bearing **NE.** by **E.** ¾ **E.**, distant 3⅛ miles. There may be less water on the shoal, as the locality was not fully examined.

Anchorage.—The usual anchorage at this island is off the west side of Reef Point, and there is also an anchorage on the east side, off Black Bluffs. From the anchorage on the west side the village is hidden, but there is a flagstaff on the top of the hill overlooking the bay; from the Black Bluffs anchorage the village is in full view, and there is another flagstaff, the lower of the two, on this side. If a vessel is seen approaching, the United States ensign is hoisted on the flagstaff on the side on which she ought to anchor, and the ensign is kept flying if landing is safe, but hauled down if it is not safe.

Vessels should not attempt to ride out a gale at anchor near the islands, unless to leeward and well sheltered. The surf is apt to make quickly and is dangerous on the weather side of the island.

Landing.—In Village Cove, the landing place on the west side, a bar extends across the entrance on which the sea breaks unexpectedly, and is often dangerous for boats.

The landing on the east side is a small cutting in the rocks, close to a boathouse, which is the only house near the beach; with westerly winds landing here is easy.

A landing can sometimes be made at the head of the cove on the south side of Lukanin Bay, when impracticable at Black Bluffs or Village Cove.

Village.—The village consists of a number of small wooden houses, painted white, with dark roofs, a church, also several larger buildings for the Government Agent and the officers of the North American Commercial Company (who in 1890 obtained a lease of the Pribilof seals for 20 years). There are about 250 inhabitants.

Tides.—See tide table, pages 10–11.

Tidal Current.—Around St. Paul Island the flood tidal current sets eastward and the ebb westward, following the trend of the shore. Its velocity at the surface is 2½ knots an hour at springs, and 1 knot at neaps. Below the surface its velocity is much greater. The tides and tidal currents are greatly influenced by the winds.

ST. MATTHEW AND ADJOINING ISLANDS.

These are rocky, uninhabited islands, whose shores are little known and are poorly charted. During the season of navigation fogs are very prevalent in their vicinity and vessels should keep away from them. From what is known of them, anchorage may be made with an offshore wind on nearly all sides, though the shore should be approached with great caution.

Pinnacle Island is a remarkable narrow rock, about 1 mile long, 200 yards wide, and 900 feet high, which rises so abruptly from the water that there is scarcely a place for a boat to land. There are numerous small rocks near the shore of the island, and it should be avoided.

ST. MATTHEW ISLAND.

Cape Upright is high and vertical, and the land in its immediate vicinity is mountainous; off the cape is a detached rock about 25 feet high. Westward of the high land of the cape there is a low neck, apparently of sand, and the cape might easily be mistaken for a detached island.

Glory of Russia Cape is also high and mountainous, and the land between it and Cape Upright is a succession of hills and low valleys, that extend across the island from north to south.

There are numerous detached rocks along all the shore of this island, which should not be approached too closely.

There is an abundance of fresh water on the island in streams and fresh-water lakes.

There is a good anchorage on the north side of the island in a bight 6½ miles to the westward of Cape Upright, with Sugarloaf Peak bearing **SSW.**, and westward of some outlying rocks which show well out of water and should not be approached closely. This anchorage is protected from southerly winds between southeast and southwest. Landing

is difficult with any swell at all, as the beach is of stones and rather steep. With northerly winds anchorage can be had on the south side of the island.

HALL ISLAND is high and rugged on its northeast, north, and west sides, and slopes to the southeast point, where it is low. There is a large detached rock off North Cape, and a number of detached rocks on the south side of the island. There is anchorage in 10 fathoms on the east side of the island in the bight where ruins are indicated on Chart No. 8901.

Sarychef Strait.—The tidal currents and rips are strong, and the rocks on either side give it a bad appearance. It is said to be clear in mid-channel.

Tides.—See tide table, pages 10–11.

Tidal Currents.—The flood current sets to the eastward, and the ebb to the westward, at the rate of 1 to 2½ knots.

NUNIVAK ISLAND.

This island is little known, poorly charted, and rarely approached by deep-draft vessels. For a distance of 10 miles about the island, especially on its east and north sides, the bottom is reported very uneven, consisting of ridges with deeper water between. The island should therefore be approached with caution. From the westward it presents a level shore, not high, terminating seaward in reddish bluffs. Near the center there are some mountains of moderate height that rise with a gentle slope. Except some hills, the eastern end of the island is low. In clear weather the island can generally be made out at a distance of 30 miles from any direction.

Cape Mohican, the western point, is a moderately high, steep cape with reddish bluffs.

Cape Mendenhall, the southern point, is about 200 feet high, with a steep bluff on its east side, which extends halfway to the bottom of the bight between this cape and Cape Corwin.

Cape Corwin, the eastern point, is low, with a rocky shore north of it.

Cape Etolin, the northern point, is a narrow strip of land about ¾ mile long, curved something like an interrogation point. There is a ridge of low hills about midway of this outer strip. A small island lies about 2 miles off the end of the cape with rocky ledges between it and the point of the cape.

In 1899 the U. S. S. *Corwin* cruised completely around Nunivak Island, following the shore and outlying islands at a distance of about 2 miles, and found a general depth of from 7 to 10 fathoms. The coast is generally abrupt and rocky, with numerous bights in which anchorage was found with 3½ to 7 fathoms of water.

ANCHORAGES.—There is an anchorage in an open bay on the southwest side of the island. It is apparently clear of dangers, the water shoaling from 15 fathoms 3 miles to 6 fathoms ¾ mile offshore, with sandy bottom. Landing may be effected in a small stream running from a lagoon to the sea, but it is exposed and difficult. There are two or three huts, where some natives live, about ½ mile up the stream.

On the southeast side of **Cape Etolin** there is an anchorage in Etolin Bay, which is a bight open to the northeast. This bay averages about ½ mile wide and nearly ¾ mile deep. Near the southerly side and about ⅓ mile from the head of the bight an anchorage in 18 feet can be found; farther out it is deeper but more exposed to the effects of the strong tidal currents and rips of Etolin Strait. The holding ground is gravel and only moderately good. There is a small native winter village at the northeast corner of the bay.

The three following anchorages are from an oral description by Capt. J. L. Fisher, who anchored with a stern-wheel steamboat in each of them in July, 1898:

The first is in the bight between Cape Mendenhall and Cape Corwin, close inshore, in 3 fathoms, with sand and gravel bottom. Fresh water can be obtained at this anchorage.

The second is in the cove on the north side of **Cape Corwin**; it is very rocky and a poor anchorage. Fresh water can be obtained here; it is discolored and of poor quality.

The third is on the east side of, and about 12 miles south of, the north end of the island. It is in a cove open to the eastward, but deep enough to afford shelter from northerly and

PUNUK ISLANDS.

southerly winds. Captain Fisher considers this the best anchorage on the east side of the island. Fresh water can be obtained at this place.

DANGERS.—Breakers are said to exist 6 or 7 miles from the southern extremity of the island.

A shoal about 10 miles **NE.** from the outer end of **Cape Mohican** is thought to cover quite an area.

The water shoals very gradually toward the westerly end of the island.

A dangerous rocky spit makes off to the westward for probably more than 1½ miles from **Cape Etolin.**

Father Barnum states that the tidal currents in Etolin Strait are so strong that the middle portion does not freeze over in winter.

ST. LAWRENCE ISLAND.

The eastern end of this island is usually made by vessels bound into Norton Sound, and in clear weather can be seen from a distance of 30 to 35 miles. From Southeast Cape a ridge of mountains extend in a northerly direction across the island, and another ridge extends in a northerly direction from East Cape to Northeast Cape. Between these two ridges a deep bight makes in from the southward and at its head very low land extends to the northward across the island. The shore of the eastern end of the island is generally a low sand beach with outlying rocks; the mountain ridges begin ½ to 2 miles back from the beach.

Punuk Islands, lying about 5 miles **ESE.** from East Cape, consist of a group of three small islands extending 2½ miles in a general northeast and southwest direction. The northernmost and largest island has two very marked rocky hummocks, the higher having an elevation of 100 to 150 feet; on the southwestern end of the island are the remains of a native village. The southernmost island is an irregular mass of rocks, the highest point about 75 feet above water. Between these islands is a low, sandy islet, which is separated from the other two by narrow channels completely obstructed by rocky ledges over which the sea breaks. The shores of all the islands are foul, and a ledge extends southward from the southernmost island for a distance of several miles. Vessels should approach these islands with caution.

A heavy break was observed in the channel between Punuk Islands and East Cape, and vessels should not attempt to pass through. From the eastward the islands can be approached as close as 2 miles.

Southeast Cape is about 5 miles across on its southern face; the eastern point of the cape slopes gradually to the water for a distance of ¼ mile from the high land, and a reef extends about ½ mile **SE.** from the point. The western point is lower and slopes more gradually to the water for a distance of 3 miles from the high land, and a reef makes off from the point in a southerly direction for a distance of 2 to 3 miles. The bight between these points is very foul and should be avoided.

Cape Krallegak, about 5 miles northward of Southeast Cape, is a long sand spit strewn with rocks, extending in a northeasterly direction from the high land of the coast, and forms what is in appearance a good anchorage in southerly winds. There are breakers about ¾ mile **NNW.** from the end of the cape, and there may be others inside; a reef extends to the southward from the south side of the sand spit for a distance of about 1 mile. The remains of a native village on the sand spit serve to identify the locality.

The deep bight to the westward of East Cape is little known; vessels have anchored well up toward the head of this bight. Vessels entering should give the points a good berth and exercise caution.

Northeast Cape is high, probably 800 to 1,000 feet, comparatively flat on top, and can be seen on a clear day a distance of 35 miles or more. The point of the cape is a low sand spit, extending about 2 miles from the high land, with two hummocks about midway between the high land and the shore. Although the bottom is irregular off the point of the cape, no break was noticed while passing it in rough weather. The north shore of St.

Lawrence Island, for a distance of 10 miles westward of Northeast Cape, is a low sand beach and grassy plain. Anchorage with shelter from southerly or southeasterly winds can be had along this shore and about 2 miles from the beach in 8 to 9 fathoms of water; the holding ground is not good, the bottom being gravel.

Cape Chibukak, probably 600 feet high, is a steep, black bluff, flat on top. There is a wide sand beach west of the bluff, on which is a native village. This native village, and the one on Southwest Cape, are the only inhabited parts of the island.

The water is deep close-to, and anchorage may be made on either side of the point of the sand beach off the native village, ½ mile from the shore, in about 7 fathoms of water, hard bottom.

The western end of the island, south of Cape Chibukak, is rolling land. From West Cape around to the bay east of Southwest Cape the land is mountainous, and abrupt close to the coast, being highest at Southwest Cape. Between the high land east of Southwest Cape and Cape Chitnak the land is low. The rest of the island is generally high and rolling. There are some sunken rocks in the bight westward of Southeast Cape, and also some detached rocks showing off the north shore near capes Kukuliak and Siepermo. It is probable that with care an anchorage may be found almost anywhere around the island, but the shores must be approached with caution.

CAPE VANCOUVER TO SCAMMON BAY.

Cape Vancouver is a bold promontory, possibly 1,000 feet high. The bank from the Kuskokwim River is thought to extend to Cape Vancouver, so that on the south side of the cape the water is shoal. Immediately off the end of the cape there is deep water, which extends about 5 miles along the north side to the bight on which the native village of Tununak is situated. This bight is a series of mud flats, mostly bare at low water. The *Bear* anchored in 4½ fathoms about 1 mile off the south point of the bight. From observation on that vessel in 1897, shoal water extends off the mouth of that bight northwestward, and Hazen Bay is supposed to be shallow.

Cape Romanzof* is a bold and prominent headland with cliffs rising abruptly from the water over 1,200 feet along its western face; at the sharp extremity of the cape there are remarkable perpendicular shafts of rock on the side of the cliff. The cape is the western termination of the Askinuk Mountains, the highest of which (2,363 feet) is about 5 miles from the cape and can be seen a considerable distance at sea.

Northeastward of the cape, 4½ miles, is the southern end of the Sand Islands. These two islands extend in a general north and south direction about 13 miles, including the interval between them, and at a distance from the coast diminishing from 7 to 5 miles. The north island is mostly covered at high tide.

The coast trends in an easterly direction from Cape Romanzof 15 miles to the mouth of Khun River, and throughout most of this distance is bordered by abrupt cliffs and hills gradually diminishing in elevation.

Scammon Bay lies between this shore and South Sand Island. In general it is very shoal with numerous bars showing bare at low tide. There are two small coves along its south side, respectively 1 and 9 miles from Cape Romanzof, but both are quite shoal. There is a limited area of water with depth of 5 fathoms just south and east of the southern end of Sand Island, and there is a channel of the same depth leading into this and passing about 2½ miles north of Cape Romanzof. A narrow channel with a minimum depth of about 2 fathoms continues through Scammon Bay and into the Khun River. There is about 4 fathoms off Cape Romanzof but the water shoals quickly to the northeastward, so there is little protection except for very light-draft boats. There is a large shoal area with breakers about halfway between the cape and the Sand Island, and another shoal with less than 2 fathoms lies **NNW.** (true) from the cape distant 2½ miles. Along the high land forming the south shore of Scammon Bay the water is 1 fathom or less in depth throughout its length, excepting just inside of Cape Romanzof.

* On some recent charts Cape or Point Dyer, an unimportant bluff on the south shore of Scammon Bay, has been confused with Cape Romanzof.

North from the mouth of the Khun River the coast is low and marshy to the Yukon River mouths. It is reported to be extremely shoal between the northern Sand Island and this shore.

The bay lying south of Cape Romanzof has not been explored, but a number of bars, bare at low tide, were seen extending across its entrance between the cape and the north end of an island; near the latter there appeared to be a channel. The coast between Cape Romanzof and Nelson Island is low, and it is reported that the adjacent waters are shoal.

The **Yukon Flats** extend from Scammon Bay to Stuart Island and should not be approached by deep-draft vessels nearer than in about 8 fathoms of water. (See page 40.)

NORTON SOUND.

Norton Sound is at present the most important arm of Bering Sea. All the supplies for the Yukon River by way of St. Michael pass through it. The north shore is also important because of the mining operations now conducted there. The south side of the entrance to the sound is occupied by the extensive Yukon Flats, and should be avoided by deep-draft vessels. The rest of the sound generally has soundings of from 8 to 12 fathoms, the greater depths being near the north side. Off Cape Nome and Cape Darby there are spots having depths of 14 to 15 fathoms. The bottom of the sound is very even, the depths decreasing to the shore with marked regularity, and the lead will indicate the approach to dangers, and should be kept going constantly. There is driftwood on all the shores of the sound.

Fog.—The remarks on fog, page 9, apply also to the region west of Cape Nome, but not to Norton Sound east of it. On entering the sound with thick weather in Bering Sea, the fog will almost always thin out and gradually clear as the vessel proceeds up the sound. At St. Michael fogs are rare.

Mirage.—In the vicinity of St. Michael and Stuart islands and the coast to the southward mirage often distorts the appearance of the land, small objects being sometimes greatly magnified.

Stuart Island lies northwest of St. Michael Island, from which it is separated by Stephens Pass, about ⅔ mile wide in its narrowest part. Stuart Mountain, 480 feet high, east of the center is the highest point. The rest of the island is low and rolling, with some small scattered peaks. The shore of the island is very irregular. From North Point to Observation Point and around through Stephens Pass is a line of conspicuous bluffs about 170 feet high; the rest of the coast is much lower. From Observation Point to the west point of the island the shores are bold and free from outlying dangers; 3 fathoms can be carried close in to the beach. Off the west point, some detached rocks extend for about 300 yards, but the reef formerly shown at this point does not exist. On the east face of the island well toward the south point a reef and shoal water make out for about 2 miles.

St. Michael Island is separated from the mainland by a narrow, crooked, tidal slough, called St. Michael Canal. The island is generally low, and has two conspicuous elevations: St. Michael Mountain, near the center, 172 feet high; and Stephens Mountain, a sharp, conical hill overlooking Stephens Pass. A reef extends some distance off Rock Point, which should be given a berth of 3 miles.

Whale Island, lying close off the east end of St. Michael Island, is about ½ mile long east and west, 100 feet high, and on approaching the harbor its east end is seen as a vertical bluff. The passage between this and St. Michael Island is completely blocked by rocks, which are bare at low water. Eastward and northward of the island the water deepens rapidly.

Beulah Island, about ¼ mile northwest from Whale Island, is about 50 feet high. It is small and rounded like a haystack. It has bold water off its northeast side. Between this and Whale Island the water is shoal.

Egg Island, about 10 miles northeast from St. Michael, is a flat, rocky island about ½ mile in diameter, and probably not more than 50 feet high. It is clear of dangers away from shore, and anchorage can be had all around it. With northerly winds, when too rough to lie in St. Michael Bay, a good lee can be found under Egg Island.

ST. MICHAEL.

St. Michael, on the east point of St. Michael Island, is the point of transfer from deep-water vessels to the Yukon River steamboats of the trading and transportation companies doing business on the Yukon and its tributaries. This trade during the open season of about four months is very extensive, and of late years has been greatly increasing. Some of the companies have small wharves for the light-draft river vessels, and extensive warehouses on St. Michael Island and opposite on the mainland. Seagoing vessels discharge their cargoes by lighters.

Supplies.—The trading companies maintain stores, which carry extensive general supplies. Hotels are maintained by three or four of the companies. Fresh water is very difficult to obtain.

Repairs.—The facilities for repairs above water and to woodwork are good. Several blacksmith shops and small machine shops can handle ironwork and minor repairs to machinery.

Anchorage.—There is no harbor for seagoing vessels, the anchorage being a roadstead open from northwest through north to east, and is unsafe with heavy northerly weather. The bay is extensive, and on account of the very gradual shoaling vessels are compelled to anchor in from 3 to 4½ fathoms at a distance of 1 to 2 miles from the nearest landings. In heavy northerly weather vessels have to shift anchorage to deeper water, obtain shelter under Egg Island, or go to sea.

Light-draft vessels and river steamers can find shelter from northerly and westerly storms by anchoring close in under the east side of the island, in from 3 to 8 feet. The shores of St. Michael Bay are strewn with loose rocks, which are often frozen in the ice in winter and dropped as it goes out in the spring. Light-draft vessels, when anchoring in shoal water, should be careful not to anchor over any of these loose, scattered rocks.

Tides.—See tide table, pages 12–13.

Ice.—See table, page 14.

The coast from St. Michael Bay to Tolstoi Point is generally low, and the beach is rock-strewn; but as far as known it is free from outlying dangers, and depths of 3 to 4 fathoms can be carried quite close to the land.

Tolstoi Point and its vicinity are high and rocky, and from there to Unalaklik River the shore is low. The soundings decrease regularly to the shore, except off the mouth of Unalaklik River, where shoal water extends probably 1 mile. Just north of Unalaklik the land can be approached to within ½ mile with a depth of 3 fathoms. The head of the bight to the eastward of Cape Denbigh is said to be somewhat shoaler than the shores to the southward.

Besboro Island, about 600 feet high, is steep-sided and rounded. It is very prominent, and on a clear day can be seen from St. Michael Bay. Its shores are not known.

Cape Denbigh is a moderately high, rounded hill, joined to the mainland by a low, narrow neck.

Norton Bay has not been recently navigated by vessels, and the head of the bay is said to be too shoal except for vessels of very light draft. In this region the lead is the only guide that can be depended upon.

Cape Darby is a high, rounded mountain, which terminates at the water in steep, rocky bluffs. Off the cape the water is bold.

Rocky Point is somewhat similar in appearance to Cape Darby, but not so high. It was so named because of a flat, bare rock close to it. The water off this cape, though not so deep as off Cape Darby, is good close-to.

Golofnin Bay, the entrance to which lies between Cape Darby and Rocky Point, with a width of 10 miles, extends in a general northerly direction for 12 miles to the entrance to Golofnin Sound. The east shore is high and bold, with occasional sand and gravel beaches. **Carolyn Island,** low and rocky, lies ¼ mile off the east shore, about 8 miles north of Cape Darby. The west shore for about 4 miles north of Rocky Point is high and bold, but beyond this is a low sand beach, with a prominent point about 5 miles north of Rocky Point. At the head of the bay on the west side the entrance to Golofnin Sound lies between a sand spit projecting from the eastern shore and a low sand island connected at low water with the west shore and extending northward.

Deep water can be carried close under Cape Darby and Rocky Point. To the eastward of Rocky Point is an extensive middle ground on which the least depth found was 3¾ fathoms; on its east edge it rises abruptly from 6 and 7 fathoms. With the exception of this middle-ground, the bay is free from dangers south of the low point on the west shore, the deepest water being on the east side, and ranging from 11 fathoms close under Cape Darby to 4 fathoms, ½ mile northwest of Carolyn Island. In the south part of the bay the highland may be approached closely, but off the lowland the 3-fathom curve is in places nearly 1 mile offshore.

In the north part of the bay an extensive shoal, with but 8 to 9 feet, makes out in a northeast direction from the west shore to within ⅜ of a mile of the east shore, its extremity lying about 2 miles **ENE.** from the low sand island on the south side of the entrance to Golofnin Sound. The channel leading to the entrance to Golofnin Sound lies on the eastern shore of the bay, passing around the east end of the shoal and following the shore at a distance of ¼ to ½ mile, with an average width of 800 yards. The shoalest water in the channel is 12 feet at low water, but 15 feet has been taken in at high water. The rise and fall of the tide (diurnal) is about 3 feet, but this is influenced by the prevailing winds, which have a tendency to bank up the water in heavy southerly weather, and to lower it with northerly and northeasterly winds.

Anchorage.—Close under and immediately to the westward of the southern sand spit, anchorage may be had in 6 to 7 fathoms, with protection from all winds. For vessels whose draft prevents the use of this anchorage, the best is off the point on the west side of the bay in about 4 fathoms. This is unsafe in southerly weather, but is the most convenient for communicating with the head of the bay.

Golofnin Sound has not been examined, but is believed to be shoal.

Rocky Point to Cape Nome.—For about 25 miles west of Rocky Point the land is high and bold, in many places rising abruptly from the shore. Beyond this to Cape Nome the land at the shore is low with high land farther back. Immediately behind this lowland is a large shoal lagoon with two small entrances, the west one being known as Port Safety. Between Rocky Point and Cape Nome the water is deep, the bottom regular, and, as far as known, there are no dangers.

Port Safety is a small anchorage for vessels of less than 7 feet draft; it is about 8 miles to the eastward of Cape Nome. The channel is very narrow and has a depth of 7 feet. Small vessels can anchor in the narrow sloughs which lead between the flats inside the entrance.

GENERAL DIRECTIONS FROM UNIMAK PASS AND UNALASKA BAY TO ST. MICHAEL.

For vessels of any draft.—Vessels that do not touch at Unalaska Bay ports go through Unimak Pass.

From Unalaska Bay or Unimak Pass the course is shaped to sight the west end of Nunivak Island and pass it at a distance of from 15 to 25 miles. On this course little can be said of the currents that may be experienced, except that with a strong wind in any direction a current is likely to set with it. A slight set northward will be experienced at times. Thick weather is the rule on this course, and care should be observed when in the vicinity of Nunivak Island.

When due west of Nunivak Island the course is shaped for a position 35 miles east of St. Lawrence Island. The east end of the island is high, and will be easily made out at this distance in clear weather. On this course thick weather is the rule, and the set of the current is northward and westward, especially as St. Lawrence Island is approached.

"When due east of the east end of St. Lawrence Island, change course and head for Cape Nome. On this course there is usually quite a current coming from the Yukon delta and running toward Bering Strait. During the freshet season a current of the roily river water carrying driftwood will be crossed. In the fresher portion of this ocean stream the water was found to be one-fifth as salt as sea water." On this course thick weather is not so prevalent as farther south.

When Cape Nome is distinctly made out and the position fixed, which will not be, even in clear weather, until the vessel has about reached the 64th parallel, a straight course can be shaped for North Point of Stuart Island. But if the weather is thick on nearing Cape Nome, vessels should stand on until sure of being as far north as the 64th parallel, and then stand into the sound on this parallel until Cape Darby and Rocky Point are made out, when the course can be shaped for North Point of Stuart Island as before, steering to pass it at a distance of about 3 miles. On the course for Stuart Island in clear weather the mountains on the mainland, southeast from St. Michael, are first sighted, though the mountain on Stuart Island and St. Michael Mountain can usually be seen at a long distance. In this part of the sound thick weather is not so frequent as in Bering Sea.

When North Point of Stuart Island is abeam, distant about 3 miles, change course to **E.** by **S.**, giving Rock Point a berth of about 4 miles. When Whale Island is abeam haul to the southward for St. Michael Bay, and anchor according to depth. On the course from Stuart Island when off Rock Point, the houses, and at night the lights, of St. Michael show across the land to the westward of Whale Island, and strangers should be careful not to enter the bight between it and Rock Point by mistake.

Dangers.—If no observations can be obtained on account of thick weather, the lead must be depended upon and used constantly, as the currents are liable to set a vessel off her course.

Yukon Flats.—From the latest surveys, the lowland of the Yukon delta has been found to extend nearly 15 miles farther westward than had heretofore been supposed, but the shoals do not extend any farther westward than shown on present charts, except at their northwest extremity.

From a point 5 miles west of Cape Romanzof, the 5-fathom curve extends due north about 100 miles to longitude 165° 05′ W., latitude 63° 25′ N., when it turns eastward, and runs about east-northeast for 65 miles to the west point of Stuart Island. On the west edge of the flats the 3-fathom curve is seldom more than a mile inside the 5-fathom curve, but on the north edge this distance increases eastward, becoming greatest in the vicinity of Point Romanof, with a long pocket under the south shore of Stuart Island. When in the vicinity of the flats vessels should not shoal the water to less than 8 fathoms.

From the information obtained by recent surveys the following sailing directions are believed to be safe and practicable, but they are not intended to supersede the sailing directions given elsewhere until the results of the surveys have been charted.

Vessels clearing North Point, Stuart Island, by 3 miles, may steer **WSW.**, and having made good the course for a distance of 90 miles, being in longitude 165° 40′ W. and latitude 63° 40′ N., may shape a course to the southward to clear Nunivak Island by a distance of not less than 15 miles.

Vessels bound to Cape Nome may shape a direct course **N. ⅝ W.** when not less than 15 miles west of Nunivak Island, or **S. ⅝ E.** when bound south from Cape Nome. These courses clear all dangers and will pass about 28 miles west of Cape Romanzof (on some charts Point or Cape Dyer), which will be plainly visible at this distance in clear weather.

Attention is again called to the caution that on these courses the water should not be shoaled to less than 8 fathoms in the vicinity of the flats.

From the survey of the United States Coast and Geodetic Survey Steamer *Patterson* in 1899, the shoal spots northward of the flats shown on the charts could not be found, and probably do not exist. The vessels reporting them have probably been on the north edge of the flats.

Rock Point.—A shoal makes off about 2 miles from Rock Point, the north point of St. Michael Island. From the outer extremity of the shoal the east end of Whale Island bears about **SE.** by **S.**

GENERAL DIRECTIONS FROM ISANOTSKI STRAIT TO ST. MICHAEL.

The following directions are intended to apply only to small vessels and river steamboats:

After passing out of Isanotski Strait to the northeastward, clear of the outlying breakers (see Isanotski Strait, page 14), the course is shaped for the east side of Amak Island. Shelter can be found on the south, southeast, and east sides of the island. Some of the Moran fleet found shelter in 1898 on the east side in about 6 fathoms. Capt. J. L. Fisher states that he crossed pretty close inshore over the indicated shoal off the southeast end, with a least depth of 7 fathoms. He also states that the outlying rocks and reefs off the north end of the island appeared very nasty and dangerous.

Leaving Amak Island, the next course is laid for Cape Newenham. Shelter can be obtained, it is believed, on either side, according to the wind. On July 15, 1898, the bight northeast from Cape Newenham was found packed full of ice by the small steamer *Joe Matthews*.

From Cape Newenham the course is laid for Nunivak Island. If heavy northerly or northeasterly winds are encountered before the island is reached, shelter is sought in the depth of the bight on the south side. Weather conditions being good, it is only necessary to touch at this island for water. The anchorage on the east side, about 12 miles south from Cape Etolin, is considered the best. (See Nunivak Island, page 34.)

From the northern end of Nunivak Island, the customary course is to cross over diagonally to a little north of Hazen Bay, and then coast along just outside the shoals, in from 3 to 5 fathoms of water, until Cape Romanzof is reached. If the weather is unpropitious or water is required, an anchorage in Scammon Bay is made close inshore on the south side, in a bight where a stream empties.

After leaving Scammon Bay, by giving the spit on the north side of the entrance a good berth, the remaining distance to St. Michael is made by skirting along on the outer portion of the Yukon Flats, in from 2 to 5 fathoms, where the courses are exclusively guided by the use of the lead. On this crooked stretch, after the mountains of Cape Romanzof and the Kusilvak Mountains disappear, no land will be visible until the high peaks on the mainland south from Stuart Island are sighted; a little later the summits of Stuart and St. Michael islands become visible. After Stuart and St. Michael islands become defined, the course is shaped so as to go through the pass between them, and then skirt around the north side of St. Michael Island to St. Michael.

Remarks.—In the summer season, from all that can be learned, northerly and easterly winds prevail a large portion of the time between Cape Newenham and Cape Romanzof.

The **tidal currents** in Etolin Strait are strong and at times cause heavy tide rips.

Father Barnum states that there are shoals parallel with the coast, behind which small boats go when coasting between Scammon Bay and Nelson Island. He is uncertain as to their exact limits and location, but they are believed to extend from the north entrance to Hazen Bay to, or nearly to, Cape Romanzof, with passages through in many places.

COAST FROM ST. MICHAEL TO THE APOON MOUTH OF THE YUKON RIVER.

St. Michael being the end of deep-water navigation, all the Yukon traffic beyond this point has to be conducted with vessels drawing 5 feet or less. The larger class of river steamboats leaving St. Michael Bay go around the north side of St. Michael Island and through Stephens Pass, between St. Michael and Stuart islands. They give the reef off

Rock Point, on the north side of St. Michael Island, a wide berth, and after passing between the islands a straight course is made slightly to the westward of Point Romanof. When the summit of Point Romanof is abeam, distant about 1½ miles, the direction is changed and a straight course is made for the range beacons for entering the Apoon Pass. The most dangerous portion of the passage is the 14 miles around the north end of St. Michael Island, which is exposed to the deep-water swell from the north. This can be avoided by the small craft by going through St. Michael Canal.

St. Michael Canal.—St. Michael Island is separated from the mainland by a narrow, crooked, tidal slough, which forks and comes together again. The distance through by way of the north fork is 18 miles, and by the south one 20 miles. The southern and longest one is the widest, and for that reason is the one generally used. There is a sufficient depth of water in the canal for ordinary river steamboats, but its northern entrance, which has some scattered rocks in it, is too shoal to enter at low tide. The southern entrance has about 3 feet on its bar at mean low tide. Thus far, on account of its narrowness and sharp curves, it has only been used by the smaller class of steamboats.

From Stephens Pass to the entrance to the Apoon Pass is 42 miles along an open coast, but, owing to the protection from heavy seas offered by the flats that extend for miles to seaward, this portion of the distance is safe in summer months for the flat-bottomed river steamboats that have to traverse it.

With the exception of the promontory of Point Romanof, the immediate coast line is very low and flat all the way from St. Michael Island to and including the Apoon entrance. The promontory of **Point Romanof,** 340 feet high, stands well out about 12 miles westward from the high hills of the coast range. After clearing Stephens Pass it appears in clear weather like an island in the sea. Coming north from the Apoon entrance after passing Point Romanof, Crater, St. Michael, and Stuart mountains appear above the horizon, and afford excellent landmarks.

In moderate weather the ocean swell is not felt between Stephens Pass and the Apoon entrance; but in heavy weather and westerly weather, which is more likely to occur during the latter part of the season, there is a choppy sea which is heavier off Point Romanof than elsewhere. In general, after rounding the north side of St. Michael Island, this passage is safe for river steamers in the summer season. During the latter part of the season, however, high winds become more frequent, and the boats are obliged to watch their opportunities.

Anchorages.—River steamboats anchor on the flats or in the channel, wherever exigency demands.

Good shelter can be had in all but southwesterly weather in the cove on the south side of Cape Stephens, in from 6 to 9 feet of water. Stebbins, a large Eskimo settlement, is located on this cove.

In the southern end of **St. Michael Canal,** in the southern branch just above the junction, there is a good and safe anchorage in all kinds of weather. There is only about 3 feet at mean low tide on the outside bar, and it has to be crossed at high tide.

About 10 miles southward of Canal Point is the **Pikmiktalik River.** In the mouth of the right-hand stream there is an anchorage for medium-sized steamers. The bar to this stream has only about 2½ feet on it at mean low tide. A shoal extends out from the south point at the entrance.

The mouth of the **Pastoliak River,** about 2 miles from the outer end of the Apoon Pass, affords anchorage for steamboats under medium size. The Apoon Flats extend in front of the entrance, and it can only be entered at high tide.

APOON PASS.

This is the most northern outlet of the Yukon River, and is about 55 miles, via Stephens Pass, from St. Michael. With the exception of two steamboats that entered the Kwiklowak Pass during the season of 1898, it has been used exclusively for more than twenty years by the steamboats trading up the Yukon and its tributaries.

The Apoon Pass is the extreme northeastern limit of the Yukon Delta. In common with the rest of this region, the country is low and flat, it being from 1 to 2 feet above high-water mark. Down to within about 2 miles of its mouth, the banks are generally covered with low willow and alder bushes, averaging 8 to 10 feet in height. Near the mouth the land becomes more marshy, and a considerable area westward appears to be entirely an open marsh. The open country to the eastward is flat, and is made up of marsh, ponds, and tundra. The only high ground in the general vicinity is **"Hog Back,"** a rounded ridge about 300 feet high lying 5 miles east from the entrance. Some distance back from the coast, 12 to 18 miles, is seen the range of hills or mountains trending to the southwestward, which extend in that direction to where the Yukon makes its great bend to get around the end of this ridge. On these low, flat shores there are often remarkable mirage effects, tending greatly to magnify insignificant objects.

Bar.—Off the mouth of Apoon Pass, and for some distance northwestward, the bottom is nearly flat, having a depth of about 2 feet of water at low tide, and with little choice as to a channel. All but very light-draft vessels must time their departure from St. Michael so as to cross these flats at high tide, or must wait for the tide. From a point about halfway between the mouths of the Pastoliak and Pastolik rivers there is a distinct channel, having two sharp bends in it, leading into the Apoon, with a minimum depth in 1898 of 4½ feet at low tide. The channel from the Pastolik shore into the river was well marked during the season of 1899 by tripods of boiler tubes at short intervals on each side. On account of the ice, however, any marks would have to be replaced each season.

THE APOON AND KWIKPAK PASSES.

The distance between the Apoon mouth and the head of the delta is traversed by going up the Apoon Pass about 31 miles to where it branches off from the Kwikpak Pass, and then up the Kwikpak about 30 miles to the head of the delta, where it and the Kwiklowak Pass separate the Yukon into two principal mouths.

The **Apoon Pass** has a narrow and tortuous channel, averaging less than ⅓ mile in width between banks. The channel is rather difficult from the entrance to opposite **Kotlik,** the worst place being the shoals at the mouth of the Kotlik River. The channel is very narrow here, with but 5 feet at low tide, and close to the lower point of the island in front of Kotlik. As it is necessary to cross the bar on or near high water, the portion from Kotlik down is naturally traversed with a water above mean tide, which makes navigation simpler and easier.

Above Kotlik there is good water and no difficulty except between the shoals where the **Okwega** makes off. Here there is a shoal making upstream from the lower point of Okwega outlet, and also a shoal in the middle of the Apoon abreast it. The channel, with 7 feet, is between the two shoals. The only other troublesome place in the Apoon is where it branches from the Kwikpak. Here for 2 miles upstream it is full of shifting bars and shoals. There is a crossing carrying 5 feet, but no directions can be given for its location. Beyond this point there is no difficulty in navigating the Kwikpak until the crossing at New Fort Hamilton is reached, 15 miles upstream. Here the channel and shoals are constantly shifting and the lead is the best guide. There are no other difficulties in navigating the Kwikpak, when free of ice.

The **Aproka** is characteristic of many of the narrow channels in the delta. It is a cut-off about 14 miles below the head of the delta between the Kwikpak and the Kwiklowak passes. The cut-off is about 7 miles long, and, if going from the lower portion of the Kwikpak to the Kwiklowak, by taking this route a saving of about 30 miles will be made. The Aproka, although crooked, is deep all the way through, with the exception of the entrances, where there are only about 4 to 5 feet.

Inhabitants.—The natives are mostly migratory, living at different places at different seasons. Their principal settlement, after leaving St. Michael Island, is on the Pastolik River. They are generally good-natured and extremely curious and friendly. The first

white resident southwest from St. Michael is a half-breed Russian trader, by the name of Komkoff, living at Kotlik, about 6 miles from the Apoon mouth, on the Kotlik River, a short distance from and in sight of the Apoon. Here is a store, a rude Greek church, and a few dwellings. There is no other white settlement until New Fort Hamilton is reached, on the Kwikpak 36 miles above Kotlik, where there is a station of the North American Trading and Transportation Company.

Pilots.—River steamboats in general carry Eskimo pilots, who may be hired at St. Michael and at various places on the river. They are, as a rule, familiar only with a portion of the river, those from St. Michael usually going up as far as Andreafski. A number of native pilots live at the village near the mouth of the Pastolik River. A pilot is necessary in following the Apoon unless familiar with or in possession of a minute sketch directory. The Eskimos are generally quick-witted and have a good eye for the water; but some who offer their services as pilots have little idea of the requirements of a steamer, being used only to their own skin boats.

Tides.—The tides at this entrance, as is the case with the shores of eastern Norton Sound, are greatly affected by the winds, northerly and easterly ones making low waters, and southerly and southwesterly ones making high waters. The wind effect may be sufficient to entirely obliterate the natural tidal conditions. The effect of the tides reach above the head of the delta. At the head of the Kwikpak Pass the rise and fall is about 6 inches. (See tide table, pages 10, 11, 12.)

Current.—The ordinary outflow of the Apoon is much less rapid than other mouths of the Yukon; but there is a tidal inflow and outflow, the strength of which depends upon the amount of the rise and fall of the tide at any particular time.

Ice.—In the fall thin ice begins to run in the river the latter part of September, and navigation in October is attended with danger of being frozen in. It is more than probable that the movement and clogging of the ice in the breaking up of the river in spring has much to do with the location and peculiarities of the channels and with clearing it perfectly from snags.

Supplies.—Immediately within the Apoon mouth the water is fresh, and that on the flats outside, close in, is nearly so, the degree of freshness depending upon the stage of the tide.

Cord wood is cut and sold by the natives along the river from the mouth up. Small wood piles can be seen at frequent intervals. That in the delta, and more particularly near the mouth, is of inferior quality, being cut from wet driftwood. The price of cord wood, as well as of pilot services, has been very materially increased since the beginning of the Klondike excitement.

SAILING DIRECTIONS, ST. MICHAEL BAY TO APOON MOUTH.

Coast around the north shore of St. Michael Island, giving Rock Point a berth of not less than 1 mile, and the shore between Stephens Mountain and Cape Stephens a berth of not less than ½ mile. From abreast the Alaska Commercial Company's dock to Cape Stephens is 13 miles.

When Cape Stephens bears **E.** by **S.**, distant ⅓ mile, steer **S.** by **W.** ¼ **W.** for 25 miles, which will bring the summit of Point Romanof abeam and distant 1½ miles; then change course to **SSW.** ¼ **W.** for about 14 miles. In crossing the flats northwestward of the Apoon Pass, strangers must be guided by the charts and any beacons and buoys that may be placed.

The foregoing **S.** by **W.** ¼ **W.** course crosses, at about one-third the distance from Cape Stephens to Point Romanof, a shoaler place, with about 4 feet at mean low tide. If this course is being made at or near low water, it is preferable to go farther seaward. The two following courses, covering the same stretch, will carry not less than 6 feet at mean low tide:

When Cape Stephens bears **E.** by **S.**, distant ⅓ mile, steer **SSW.** ½ **W.** for 12½ miles, then change course to **S.** and continue for 13½ miles, which should bring the summit of Point

Romanof abeam and distant 1½ miles; then use the course **SSW. ½ W.** Point Romanof to Apoon Bar, as before.

THE KAWANAK (OR KWIKPAK) BAR AND PASS.

This is the middle one of the three important passes of the Yukon Delta. The entrance from the sea is 95 miles from St. Michael by way of the Yukon flats, and is in latitude 62° 57′ N., longitude 165° 11′ W., 13 miles offshore.

The channel carries 10 feet over the outer bar at low water, and 9 feet over the inner shoal which is in sight of the coast. Two lines of breakers lie on either side of the outer bar. From the seaward entrance the channel to the mouth of the pass is 20¼ miles. It is narrow and crooked, not feasible for navigation, and for the last 10 miles inshore there are numerous shoals exposed at low tide on the seaward side of the channel. The coast is low and marshy, being only about 3 feet above low tide, and is not visible until halfway up the channel. This part of the delta is 10 miles farther west than shown on recent charts.

From the mouth of the pass, 18 feet can be carried with little difficulty to New Fort Hamilton on the Kwikpak, a distance of 35 miles.

Kawanak Pass from its mouth to where it joins the Kwikpak runs generally parallel to the latter for 20 miles, and carries much the larger volume of water.

Currents.—The maximum velocity does not exceed 2 knots.

Inhabitants.—There are only natives in this part of the delta. Two summer villages are about 4 miles up from the mouth of the pass.

Weather.—The weather is similar to that in the other parts of the delta.

THE KWIKLOWAK* BAR AND PASS.

This outlet is by far the largest of any of the passes leading to the Yukon. The entrance is 125 miles by water from St. Michael, and about 80 miles by way of the flats from the Apoon mouth. The nearest harbor for vessels under medium size is Scammon Bay, a distance of 60 miles from the entrance and about 42 miles from the Kwiklowak Bar crossing. About 6 feet, at mean low tide, can be carried in over the Kwiklowak Bar through the **Acharon Channel.** The crossing place is about 16 miles southwest from the entrance, and about 4 miles off the low shore, which can not be seen until within 3 or 4 miles of it. When once well inside the entrance, the pass has remarkably good channels, which are easy of navigation and free from rocks and snags. Its minimum depth between the entrance and the head of the delta is 20 feet, and this depth can be carried up the Yukon as far as the survey of 1899 extended, to near Andreafski. There are several stretches where the depth is more than 50 feet, and at some places depths as great as 84 feet were found.

The lower portion of the Kwiklowak, which is confined between continuous banks, is about ¾ mile wide, after leaving which there is a very abrupt physical change in its condition by spreading out northward and westward, with numerous minor channels, while the main river widens to about 1¾ miles; beyond this it spreads out over the flats, through which its main channel is only fairly well defined at extremely low tides. All the shoals and flats are covered at high water, and there are no islands or bare shoals off the entrance at high tide. Besides the Acharon there are four other channels at this mouth leading out on the bar in widely divergent directions. Some of these carry across the bar slightly greater depths than the Acharon, but all are narrow, crooked, and bordered by shoals bare at extreme low tides. None of them afford a practicable entrance for deep-water vessels at the present time.

The main channels are everywhere free from snags, though trees are sometimes seen temporarily lodged on the bars, and quantities of driftwood are piled along the shores in places. Undoubtedly the ice freezes in and carries off the snags when it goes out each season. The channels and banks show indications of changing rapidly both from erosion

*On the older charts called Kusilvak.

and deposit. Very probably much of this is effected each year during the breaking up of the ice, its consequent jams, and the great floods following.

The land along the outer shores is only a foot or two above high water, is covered only with low marsh grass, and is entirely lost to view when but a few miles offshore. The only landmarks visible in clear weather are the sharp peaks of Kusilvak Mountain and the Askinuk Mountains back of Cape Romanzof, all very distant and often obscured by clouds or mist. The extreme flatness of the land and the remarkable mirage effect, often seen over the shoals when bare, make the whole region deceptive at times. When well inside the confined banks of the Kwiklowak, the country on each side is covered with an almost continuous growth of willow and alder bushes. The water has a brownish-white appearance, something like glacial water, without its fine, sharp grit. It has no unpleasant taste, and is always fresh in the inner channel.

Inhabitants.—No white men live in the delta south of the Apoon except the Catholic missionaries at a summer fishing station. There are large Eskimo settlements at the mouths of the Kwiklowak and Kripniyuk rivers. The natives are friendly and honest, and will attempt to pilot boats, with more or less success.

Currents.—None were observed to exceed 3 knots per hour. In the delta channels currents were observed varying from 0.5 to 1.6 knots. The velocities were greater in the bar channels and up the river.

Weather.—The prevailing winds in summer are northeasterly, easterly, and southeasterly; the strong blows are believed to come from the same directions. Fogs were unusual, but there was a good deal of thick mist and rain.

The **Kripniyuk River** entrance is narrow, crooked, and has a stronger tidal current than the Kwiklowak.

COAST FROM CAPE NOME TO BERING STRAIT.

Cape Nome is a bluff, about 300 feet high, apparently 1 mile broad, and rounded down to the water on either side, where there is low land at the shore, with higher land farther back. The water off this cape is quite deep.

Sledge Island, about 25 miles west of Cape Nome and 4 to 5 miles offshore, is a rocky, flat-topped island rising over 600 feet above the water, and comparatively rounded in outline. There is a native village on a small, rocky slope on the east side; excepting this and a short sand spit making off from the northern end of the island, the shores are very steep. The island may be safely approached from any direction, and anchorage may be had on all sides of it; rocky bottom is reported in some localities. A least depth of 6½ fathoms has been found in mid-channel between the island and the mainland. This island is shown too far offshore on the charts.

From Cape Nome to Point Rodney the shore, except abreast of Sledge Island, is a comparatively straight stretch of low sand beach with no protecting points and the higher land some distance back. Abreast of Sledge Island for a distance of several miles the hills slope down to the beach, giving this part of the coast the appearance of a point. The stretch of beach is broken by a number of small rivers where mining operations are being carried on. The entrances to Nome River, Snake River, and Sinrock River have shifting bars, but there is generally water enough in the channels over these bars to permit light-draft river steamers to enter. When approaching the shore, between Cape Nome and Point Rodney, the water shoals regularly and gradually until a depth of 5 fathoms is reached; inside this depth the bottom is irregular, especially near the mouths of the rivers. Near Cape Nome the 5-fathom curve is from ½ to ⅔ mile, while near Point Rodney it is from 1 mile to 1½ miles from the shore. **Nome City** is on the beach at the mouth of the Snake River, about 11 miles to the westward of Cape Nome. The general anchorage for deep-draft vessels is in 7 fathoms of water, about 1 mile from the beach abreast of the town. Vessels of less draft anchor in 5 fathoms, a little closer in to the beach, but it is not advisable to anchor in less

than 5 fathoms of water. In strong southerly winds no landing can be made on the beach, and the anchorage is unsafe. Southerly winds raise the water on the shore and northerly winds lower it.

A small shoal, with about 17 feet of water over it, is reported as lying about 8 miles to the westward of Cape Nome and about 1⅔ miles offshore; a depth of 23 feet was found just inshore of this shoal.

From Point Rodney to Cape Douglas the shore is a low sand beach, the high land is farther inland from the beach than eastward of Point Rodney. This stretch of the coast is seldom approached close-to; the water is comparatively shallow, and vessels are cautioned to exercise care when approaching the shore.

Currents.—A tidal current is perceptible from Cape Nome to Point Rodney, but the strongest current sets northwestward; lying at anchor, vessels usually tail to the northwestward. Above Point Rodney there is no perceptible current southward or eastward; the general set is northward and westward.

King Island is rugged and rocky, about 2 miles square, and 600 feet high. It has nearly perpendicular cliffs, deep water, and generally rocky bottom on all sides. There is a native village on the south side, the houses being built in the sides of the cliffs some distance above the water. Off the village, but close inshore, vessels may anchor in about 15 fathoms, muddy bottom, with good protection from northwest winds. In clear weather the island is an excellent landfall for vessels coming from the southward and bound to Port Clarence.

Cape York, at the shore line, is a high, rocky, nearly vertical cliff, with numerous distinct ravines, and a range of high, rugged mountains immediately back of it. The cliff is about 10 to 12 miles in extent. There is no distinct promontory, and no exact point along the cliff that can be defined as the cape. The water shoals slightly off the western end of the cliff, but nothing less than 6 fathoms will be found at a distance of 2½ miles from shore.

Between Cape York and the high land of Cape Prince of Wales there is a bight, with comparatively low, rolling land back of it extending across the peninsula to the northern shore. The beach is low, and the water shoals gradually when approaching the shore. The eastern part of the bight is slightly shoaler than the western part, about 6 fathoms will be found 1 mile offshore; in the western part of the bight 8 fathoms will be found at the same distance from the beach. When standing westward along shore, and when abreast of Cape Prince of Wales Mountain, the water deepens suddenly to 20 fathoms.

PORT CLARENCE.

This is a good harbor, close to the strait, free from ocean swell, and is the rendezvous for the arctic whaling fleet, that here await the tender from San Francisco which supplies them with coal and provisions and takes back the oil and whalebone of the spring catch. As a general rule, the tender to the whaling fleet arrives at Port Clarence from July 1 to 5, without encountering much heavy ice. The bay itself is clear of ice about June 25 to 30. There are three native settlements on the northeast side of the bay, and the natives assemble on Point Spencer in the early part of July for trade with the whaling vessels.

The bay is formed by a sand spit which extends from the mainland west and then north, terminating in Point Spencer in latitude 65° 16′ 40″ N., longitude 166° 47′ 50″ W. The end of the point is quite bold-to and can be approached as close as ¼ mile, with depth of 7 fathoms. The channel between Point Spencer and Point Jackson, on the north shore, is about 4 miles wide, clear of danger, and carries from 7 to 9 fathoms. One and one-half miles south of Point Spencer a shoal makes into the bay from the sand spit, having depths of 2½ fathoms 1 mile off. The northern half of the bay has a general depth of 7 fathoms as close as 1 mile from the shore; the southern half of the bay shoals gradually from this depth toward the shore, and the extreme southern part is very shoal. The north shore is

clear of danger, and can be approached as close as ¼ mile, the soundings decreasing regularly to the beach.

Port Clarence connects at its northeast end with **Grantley Harbor**, which is 3 to 4 miles wide, about 12 miles long, and connects at its eastern end by a narrow, difficult channel with a large lake farther inland. The mouth of the harbor is formed by two sand spits which slightly overlap. The water westward of the sand spits is shoal, but there is a channel close to the north one which can be used by vessels drawing 12 feet or less, but which should be sounded out before attempting to enter. Inside the harbor the depths range from 2½ to 3 fathoms, and it is probable that a draft of 12 feet can be taken through the channel to the lake. Vessels have gone into Grantley Harbor to heave down and repair on the north sand spit.

Fresh Water can be obtained in several places in Port Clarence, the best being from a stream on the east side south of Cape Riley and bearing **ESE. ½ E.** from Point Spencer.

Anchorage.—The anchorage used by the whaling fleet is in 5 fathoms, just inside Point Spencer.

Fog.—In this vicinity fog is quite prevalent and very dense in summer.

Tides.—See tide table, pages 10, 11. Southwesterly winds increase and northeasterly winds decrease the height of tide.

Current.—Outside of Point Spencer the current sets northwestward with a velocity of 1 to 2 knots per hour.

GENERAL DIRECTIONS TO PORT CLARENCE.

In approaching Port Clarence in thick or misty weather the long, low spit of sand and shingle which forms the west side of the bay is not seen until it is close-to. The best course from the southward is to steer directly for Cape York, bearing in mind the set of the current to the northwestward, and after making Cape York follow along the coast eastward until the entrance to Port Clarence is made out, then steer for the anchorage just inside Point Spencer. Between Cape York and Point Jackson depths of 7 to 9 fathoms are found about 2 miles offshore.

Dangers.—A shoal having a least reported depth of 1¾ fathoms lies nearly 5 miles offshore and about halfway between Cape Douglass and Point Spencer, and vessels should keep well outside of it. Extending about west-northwest from this shoal toward Cape York is a ridge having hard bottom and depths ranging from 4 fathoms near its southeastern end to 5 fathoms in about the latitude of Point Spencer. This ridge extends nearly to the north shore. It is recommended that vessels approaching Port Clarence give the lowland between Cape Douglass and Point Spencer a berth of not less than 5 miles before hauling in for the entrance.

ARCTIC OCEAN.

The remarks on the navigation of Bering Sea (pages 7, 8, 9) apply generally to the Arctic Ocean as far as Point Barrow, except that the current and soundings in the Arctic are more uniform, and, with the exception of the shoals at Cape Prince of Wales, Hotham Inlet, Blossom Shoals, and Point Franklin, there are no outlying dangers, and the lead is an excellent guide in approaching the land. Another exception is that in the Arctic the question of ice must always be considered. The following remarks on the navigation, weather, and currents of the Arctic Ocean, by Capt. M. A. Healy, R. C. S., contained in the report of the cruise of the Revenue Steamer *Corwin* in the Arctic Ocean, 1884, though relating to an extreme season, may be of interest to those navigating these waters:

"In my previous experience in the Arctic I have never seen a season like the past. From the time of first reaching the ice up to leaving the Arctic dense fog has been almost constant. Currents that have hitherto been considered permanent in direction, if not in force, have become erratic, and others have entirely failed. The ice fell back before the sun's advance slowly and compactly. For three weeks after we reached the Diomede Islands it refused entrance into Kotzebue Sound, and three weeks later still it was hanging with discouraging tenacity around Point Hope. It was unsafe to anchor with any but a short scope, moving steam had to be kept, and constant vigilance exercised to prevent being dragged ashore by fields of ice moving in the rapid and changing currents. For weeks at a time it was impossible to take observations, dead reckoning was almost worthless, owing to the continual changes in force and direction of the currents, and the safety of the ship depended entirely on the constant use of the lead. Fortunately for those who are obliged to sail this frozen ocean, the depth of water is not so great but what bottom can always be obtained, and the proximity of land is indicated by regular shoaling, with but few exceptions. Yet with this aid and the best charts that we have, several years' experience is necessary to enable the navigator to judge with any degree of precision the position of the ship. Anyone at all familiar with coasting knows how difficult it is to recognize land in a fog where marks are well defined—high bluffs often appearing like low beaches and small rocks looming to gigantic size, while the general contour of the small portion of the shore visible may be taken for almost any land that one expects to make. How much more difficult must it be where the formation of the shore for miles differs but little, as is the case in the Arctic.

"Among the best landmarks that we have in these northern waters are the bird rookeries. There is one at King Island, one at the Diomedes, one at Cape Seppings, one at Cape Thompson, and one at Cape Lisburne. The distance between these rookeries enables one to form a very accurate idea of the one he is approaching, while the cries of birds congregated at them admirably answers the purpose of a fog signal. With one or two exceptions, these are the only aids to navigation in this foggy, unsurveyed, and dangerous sea.

"In the shallow waters of this ocean the effect of the wind on the currents is perhaps more marked than in any other part of the globe.

"Inside the Arctic circle snow has fallen all the past season, and it may almost be said that there has been no summer. As late as August 27 ice was within a few miles of Cape Sabine, and at the Sea Horse Islands it was heavy and dangerous. The pack at this time was still to the southward of Point Barrow, and there were few indications that vessels would be able to go to the eastward of that place this season. During the latter part of our stay the weather was exceptionally severe. About the Fox Islands heavy storms were frequent and rain almost incessant. Advices received in San Francisco since my arrival confirmed my opinion as to vessels being able to weather Point Barrow this year.

"The experience of many years in the Arctic has demonstrated the fact that no rules whatever can be given as to the time of the breaking up of the ice. The severity of the

winter, the time at which spring weather opens, and the beginning of southerly winds that break up the ice, all have their influence in governing this time. Vessels have been able to enter St. Michael as early as May 21; this year we found ice to the southward of St. Matthew Island on June 2, and some days later still in the season vessels have been stopped by it between the Seal Islands and Nunivak. The southern limit of the ice is almost entirely dependent on the severity of the winter. Heavy southerly winds and swell will break up the ice, and if followed by northerly winds it will open out and the waters become navigable. When once broken up, if the weather is mild, it will not cement again if nipping, and consequently will open more readily to light winds. Northeast winds tend to drive the ice off the American shore and westerly winds off the Siberian side. With these few exceptions little can be said of ice conditions.

"In clear weather the ice blink indicates the presence of ice, and it may be seen a great distance, but in thick, foggy weather approach to the pack must be made with great caution. Its proximity is usually indicated by the slack, and when this once begins to be seen about the vessel it may be judged that a large body is not far distant. As the pack is neared one sees only ice as far as the eye can reach. It rises from 10 to 25 feet above the water, in all manner of fantastic forms and shapes, presents all colors of blue, from an indigo to an almost white, and glistens in the sun's bleak rays with a splendor blinding to the naked eye. It is a well-known fact that the depth of water and the surrounding features of this ocean render the formation of gigantic icebergs an impossibility, and no mountains of ice add the sublimity and terror of their presence to the pack, yet there is in this harmless-looking body that which man can never conquer. Inside its solid front no vessel can penetrate, and once caught within its grasp it is almost a miracle that she ever escapes. No ship can be built that will stand its crushing force, and no ram be made so powerful as to break its way through it. It is only when the elements combine against it that man can invade its domain.

"When a pack is reached it usually becomes necessary to track along its edge to find a lead. Whoever is piloting the ship takes his place at the masthead, and with glass in hand seeks for a favorable opening. Oftentimes days are spent working up and down along the ice without clear water presenting itself, and when it does extreme caution must be used in entering the lead. It is here that the judgment and experience of the ice pilot become a necessity. The weather, currents, appearance of the ice, probable winds, and a dozen other things that would never enter the mind of the novice, are to be taken into consideration before the vessel's head is turned into the pack. Once it is determined to enter the lead vigilance must be doubled and every faculty kept on the alert. The vessel is conned from the masthead, and, while directing how the helm must be put to keep clear of immediate danger, the pilot must be looking ahead for the clearest water, and watching ice, sea, and sky for change of currents and winds. If any signs of the closing-in of the lead are presented the vessel must be got out as soon as possible, for, if shut in and she escapes being crushed, she will go to the northward in the drifting pack from 1 to 2 knots per hour, and it will become necessary to abandon her. If the lead followed up is between the ground ice and the pack and the wind comes on shore, a safe place can sometimes be found behind the ground ice. A vessel may be made fast to this ice with grapnels, or anchored to leeward of it, and lay with comparative safety. If anchored in a current, however, with drifting ice about her, the scope of chain must be short, and everything kept in readiness for getting under way at a moment's notice. If anchored in shoal water, it is desirable to get in the ice as far as possible to avoid the swell; but if the water is deep the ice should be avoided. Generally the presence of the ice tends to kill the swell, and it will be found much smoother inside the ice than out.

"The bowhead whale keeps as far to the northward as he can find spouting holes, and to take him the whalers are obliged to keep as close to the pack as possible. Usually they track along the Asiatic side in Bering Sea and Strait, and, as they reach the Arctic, cross over and work up the American shore to the northward and eastward. In Bering Sea there is very little danger in entering the ice, as it is almost sure to open and offer a chance to

escape before reaching the Arctic. With a knowledge of this fact, whalers sometimes enter the ice to the southward of the strait and endeavor to work through it if they have reason to believe, from the sudden disappearance of the whale, that there is clear water to the northward. In the Arctic, however, the pack is carefully avoided, and it is only when conditions are most favorable that attempts are made to follow up the leads. Point Barrow is approached with the greatest caution, as it is one of the most dangerous places in the Arctic. As has already been mentioned, by far the major portion of the vessels lost in the Arctic are wrecked in its vicinity."

ICE.—Bering Strait is free of ice by the first week in July and sometimes earlier, but clear water does not extend very far to the northward, and it is seldom possible for vessels not fitted to encounter ice to reach Point Hope before July 10–15. Kotzebue Sound is usually open by July 15, at times a few days earlier, but it has been known to remain closed until the last of July. The running ice from Kotzebue Sound is encountered at Point Hope some time after the pack has moved to the northward. By July 15 the main pack has moved north of Cape Lisburne.

Thus far the movement of the ice does not appear to depend to such a great extent on the winds, it is reasonably certain each year, and dates can be depended upon within a small limit of time; but north of Cape Lisburne the movement is generally slow, uncertain, varying greatly in point of time in different years, and seems to depend almost wholly on the winds for its further movement. Prevailing northeasterly winds move it away from the shore rapidly and early, while southwesterly or westerly winds hold it against the shore and make a late season.

From Icy Cape north no specific time can be set for the opening of navigation. Its variations are from July 12 to the latter part of August, though an average date for the whaling vessels to reach Point Barrow is about August 1. Between these points in the early part of the season the ice is always dangerously near the shore, and southwesterly or westerly winds will bring it in. Later, the southern point of the pack is just off Sea Horse Islands and generally remains there the rest of the season. From the Sea Horse Islands to Point Barrow the pack is seldom far offshore, and from the latter point can almost always be seen. During the open season it is always liable to come in on these two points with a westerly wind.

Beyond Icy Cape there is always danger to vessels, and strangers should be cautious and careful in going there. In the lead of open water between the pack and the shore the current is swift and nearly always carries drift ice, and vessels rarely reach Point Barrow at any time without encountering some ice. The ice can not be forced, and vessels should not venture into small leads between the pack and shore ice. With a southwesterly or westerly wind, which brings the ice in, vessels seek protection east of Point Barrow when it is open, in Peard Bay close in as possible, and under the lea of heavy ground ice, which acts as a breakwater against the smaller cakes. In anchoring where there is drifting ice vessels should use a short scope and be ready to get under way immediately. A comparatively small cake will sometimes cause the loss of an anchor and chain. In the vicinity of Point Barrow sailing vessels should not go offshore in water too deep to anchor, as in light winds or calms the current is likely to take them into the pack. Navigation east of Point Barrow is such that it should only be attempted by those having experience.

As a rule, the pack does not come down on Point Barrow before the latter part of September, but in 1897 it came down the first of September, and, in general, except for whaling vessels, whose officers are men of long experience in judging the ice, weather, etc., September 1 is as late a date as vessels should remain in that vicinity. About this time, or a little later, young ice begins to make in the lagoons, along the shore, and around the old ice, though it is not likely to form in the open sea until the last of the month. The young ice makes stronger and spreads over the open sea with the advancing season. It is dangerous to vessels, and will very quickly cut through one not sheathed to withstand it. Ordinary vessels should be out of Kotzebue Sound by September 15 to 20, and out of the Arctic by

October 1. The whaling vessels make it a rule to be ready to leave there about October 10, and though there may be times when they stay later, these are exceptions.

At times there is a body of ice, which holds on the Siberian shore through the summer, that moves down past East Cape into the western side of Bering Strait, sometimes as early as the latter part of August, and makes that side of the strait difficult of navigation late in the season.

WEATHER.—In summer the weather is usually light, with much fog and rain. The winds are variable, though mostly easterly and southerly. There are seldom gales in summer, but occasionally, sometimes with intervals of years, there come southwesterly gales, short-lived but very severe and disastrous, as there is little protection from winds in that quarter. In the vicinity of the ice the weather is nearly always light and foggy. Later in the season it grows more boisterous, gales are frequent and more generally from the northward, and as the weather grows colder there is considerable snow.

CURRENTS.—From Bering Strait to Point Barrow there is a general current setting northward alongshore (stronger inshore), which, when not affected by winds or stopped by the ice, has a velocity of not less than 1 knot at any part of it. The current from the strait turns northeastward and is joined north of Cape Krusenstern by that from Kotzebue Sound. From Eschscholtz Bay a northerly current sets alongshore on the eastern side of Kotzebue Sound, having a velocity of from ½ to 1 knot at Cape Blossom. It continues past Cape Krusenstern, where it is increased by the flow from Hotham Inlet to a velocity of 1 to 2 knots, and to the northward of the cape joins the current from Bering Strait, where, in the latter part of July and August, its velocity is from 1½ to 2 knots. It continues with the same velocity around Point Hope, then with a reduced velocity to Cape Lisburne and across to a short distance south of Point Lay. After rounding Point Hope, and thence to Icy Cape, the current does not appear so strong, and, as a rule, is about 1 knot.

In the bight between Cape Lisburne and Cape Beaufort there is a tidal current, and, unless driven in by a westerly wind, the outside general current is not felt.

Northward of Point Lay, if the ice has not opened up from the shore, the current is stopped; but if the ice is open to Point Barrow the current continues along the shore and, because of the contracted space between the shore and the ice, increases in velocity to from 2 to 3 knots, and sometimes more, at Point Barrow.

This general current is more or less affected by the wind, and may be decreased or even stopped at times by northerly winds, but when the wind abates it starts again. When the wind is with the current its velocity is increased. Well offshore the currents are variable and not so strong, and depend to a great extent on the winds. There is, however, a general set to the northward.

Cape Prince of Wales, seen from the southward, is a high mountain peak, comparatively regular in outline; on the south and southwest sides the slope of the mountain comes down to the sea. The face of the cape is a low sand beach, which extends north-northwest 3 to 4 miles from the base of the mountain, and then trends northeastward toward Shishmaref Inlet. On this sand beach, close to the mountain, is the native village of Kingegan, the largest on the northern coast. Just back of the village a ridge extends several miles northward from the peak, distinguished by a number of ragged points and large fragments of rock on top.

On approaching the cape from the southwestward, nothing less than 30 fathoms of water can be had at a distance of ¾ mile from the highland at its southwestern extremity. From this point the 20-fathom line runs nearly northwest, gradually increasing its distance from shore, until 5 miles to the northward, where it is 3 miles offshore. The 3-fathom line, commencing very close to the southwest point, increases, almost at once, its distance from the shore line to 1 mile, continuing at that distance until the cape makes northeastward, where it joins, presumably, Cape Prince of Wales Shoal.

Cape Prince of Wales Shoal seems to be a ridge of sand, which extends about north-northwest from the western extremity of the cape to a distance of about 30 miles. The depth of water on the shoal is not definitely known, but numerous cases are reported of whaling vessels having struck on it at distances supposed to be 10 or 15 miles from the cape. The western face of the shoal is very steep, the depth decreasing rapidly from 20 fathoms. It is recommended that vessels give this shoal a wide berth, and not haul to the eastward when coming from the southward until at a distance of 25 to 30 miles from the cape. Vessels bound southward through the strait should be careful not to fall too far eastward and be caught between the shoal and the northern shore, especially sailing vessels with northerly or northeasterly winds.

Vessels making an **anchorage** off the native village of Kingegan at Cape Prince of Wales should approach it only from the southwestward. The soundings decrease rapidly from 13 fathoms, and anchorage should not be made in less than 7 fathoms. During the open season the current sweeps by the cape northward with a velocity of from 2 to 3 knots, and care should be taken in making an anchorage here not to be swept by this current upon the shoal.

Fairway Rock is a high, square-headed, steep-sided rock. The bottom is steep-to on all sides, and there are no outlying dangers.

Big and Little Diomede Islands rise abruptly from the sea, with nearly perpendicular sides; they are steep-to, and there are no beaches. The tops of the islands are a sort of broken table-land. The larger island is about 1,700 feet high, the smaller somewhat lower. In their vicinity the water is deep with generally rocky bottom, and the anchorage is poor. There are some rocks above water close to shore on the west side of the larger one. The native village on the larger island is on the southwest side, off which vessels can anchor in 14 fathoms, sandy bottom. The channel between the islands is about 2 miles wide. It is not generally used, but whaling vessels have passed through, carrying 20 fathoms of water, favoring the side of the channel next the larger island. There is a native village on a rocky slope on the smaller island facing this channel, off which a reef of rocks and sand is said to extend a short distance into the channel.

East Cape is a bold, rugged headland, about 2,500 feet high, steep on all sides, and with deep water quite close-to. It has low, marshy land back of it, and when seen at a distance appears as an island. There are no dangers off the land, and except at the anchorages the water is deep with rocky bottom. There is good anchorage (in 8 fathoms), with good shelter from offshore winds, on both the north and south sides of the cape, where the lowland back of it begins. There is also an anchorage (in 10 fathoms, muddy bottom) off the native village on the face of the cape.

From Cape Prince of Wales to Shishmaref Inlet the coast is a low sand beach, with lagoons and marshes back of it. On a clear day the mountains in the interior can be seen, The Ears and Conical Hill being distinguishable.

Shishmaref Inlet is a large inlet extending into the land, but it has never been explored. Across its mouth is a low sand island, with shallow openings at each end. Shoal water extends off the mouth of the inlet several miles.

From Shishmaref Inlet to Cape Espenberg the coast is higher than that westward of the inlet, and is a line of low bluffs and small sand dunes, terminating at Cape Espenberg in a very low spit, which is made out with difficulty. A number of small native settlements are scattered along this coast from Cape Prince of Wales to Cape Espenberg.

KOTZEBUE SOUND.

Kotzebue Sound is about 30 miles wide at its entrance between Cape Espenberg and Cape Krusenstern, 22 miles wide from Cape Espenberg to the shoal water off the mouth of Hotham Inlet, and extends about 30 miles south of Cape Espenberg. Except for the shoal off the mouth of Hotham Inlet, the soundings throughout the sound are very uniform, varying from 7 to 9 fathoms. From Cape Espenberg the west shore of the sound is shallow some

distance from the land, and vessels should approach it with care. The land on this side of the sound is generally low. There is a small but conspicuous hill about halfway between the cape and the southern shore. On the south side of the sound the land is higher, more rocky, and of a bolder character than the west shore. Under water, also, it is bold, and has soundings of 4 and 5 fathoms quite close to the promontories.

Chamisso Island, at the entrance to Eschscholtz Bay, is a small, rounded island having a grassy hill 231 feet high. Its shores are rocky, except its northeast end, which is a low sand spit. Along its north and east sides shoal water extends from ¼ to ½ mile offshore.

Puffin Island, west of Chamisso Island, is a rocky islet, with two conspicuous rocks southward of it. Between the island and rocks and Chamisso Island the water is shoal and rocky. The water on the north and west sides of Puffin Island is bold-to.

CHAMISSO ANCHORAGE, between Chamisso Island and Choris Peninsula, is the only place on the Arctic coast of Alaska that can be called a harbor. By shifting anchorage ½ mile good shelter can be found from all winds. Off Choris Peninsula shoal water extends toward Chamisso Island fully 1 mile. The deepest water is close to Puffin Island. In approaching the anchorage give Point Garnet, the southwest extremity of Choris Peninsula, a berth of 1 mile, and stand down well toward Puffin Island before hauling in. Anchor with Puffin Island bearing **S.**, at a distance not greater than ¾ mile, in 8 fathoms, muddy bottom.

Early in the season, fresh water can be obtained on Chamisso Island, and on the east side of Choris Peninsula.

Tides.—See tide table, pages 10, 11.

Eschscholtz Bay, east of Chamisso Island and Choris Peninsula, is generally shoal. The soundings decrease gradually from Chamisso Anchorage to 2½ fathoms at 2 miles off the point which lies 4 miles west of Elephant Point. East of this point the shoaling continues, and this part of the bay is only navigable for small boats. The shore at the head of the bay is difficult of access on account of long, muddy flats, which, at low water, are bare in some places ¼ mile from the beach. It is probable that the whole bay is gradually filling up, and vessels going east of Chamisso Anchorage should proceed with caution. Buckland River, a large but shallow river, empties into the head of the bay. There are few natives in its vicinity.

Choris Peninsula, forming the western side of Eschscholtz Bay, has two hills, about 300 feet high, separated by a low, sandy neck. Northward of Choris Peninsula the land is low for some distance, and then rises into low, perpendicular bluffs which continue to Hotham Inlet. These bluffs are composed of ice and frozen mud, which is gradually melting and sliding down, making deep furrows all along their face.

Cape Blossom is a distinctly marked point in this line of bluffs, which are highest at the cape and slope to either side.

The bottom of this side of the sound is very even southward of Cape Blossom at a distance of about 5 miles from the land; but northward of the cape a shoal, with very little water on it, extends 8 to 10 miles off the land from the mouth of Hotham Inlet, and south to within 2 miles of the latitude of Cape Blossom. This shoal is very dangerous, as the soundings give short warning of its proximity, the distance from the shore can not be judged under ordinary conditions, and there are no good landmarks.

The general **anchorage** in this vicinity is off Cape Blossom, as it is the nearest point from which communication can be had with Hotham Inlet. In approaching the cape, it should not be brought to bear to the eastward of **ENE.** until in the vicinity of the anchorage. Anchor in 5 fathoms with the cape bearing between **ENE.** and **E.** by **N.**, distant 3 miles. This anchorage is protected from northerly and easterly winds. There is generally a current, strongest in the early part of the season, having a velocity of from ½ to 1 knot, setting northwestward.

The coast from Cape Blossom to the mouth of Hotham Inlet is the place of rendezvous for the natives of the surrounding country for the purpose of fishing and trading. The

CAPE BLOSSOM, E. BY N., DISTANT 3 MILES.

coast natives from Cape Prince of Wales, including the Diomedes and King Island, to Point Hope assemble here about the last of July to meet those who come down the large rivers from the interior.

HOTHAM INLET is about 35 miles in length and from 4 to 8 miles in width. Its general trend is southeast; its water is little influenced by tides, but a prolonged southeast wind causes a low stage. The entrance is obstructed by vast mud flats and sand bars, some of which are bare at low water There is a shifting channel which is difficult to trace, running close along the shore from Cape Blossom north into the inlet, through which 4 to 5 feet can be carried. In the inlet proper the channel is said to have from 2 to 4 fathoms, and to gradually shoal toward its head. There are three large rivers emptying into the inlet.

The **Noatak River,** joining it at the north, has numerous rapids and is not navigable for any distance for boats larger than native canoes. The natives portage from the headwaters of this river to the Ikpikpung River, and thus to the Artic Ocean east of Point Barrow.

The **Kowak River** empties at the east side of the inlet by many mouths, off which shoals having from 2 to 4 feet of water extend far out into the inlet. In crossing the bar it is somewhat difficult to find a channel, but when fairly between the banks of the river there is comparatively deep water. In 1898 a large number of prospectors were attracted to the region of Hotham Inlet. Two stern-wheel steamers were used in transporting their supplies up the Kowak River, and it is said that these steamers ascended the river 200 miles. The current in the river was found very strong, running at some points with a velocity of 5 or 6 miles an hour. This current is dangerous for small boats; eight men lost their lives in 1898 while boating their provisions up the river. The natives portage from the headwaters of the Kowak River to the Koyukuk River, a branch of the Yukon.

Selawik Lake is the prolongation of the head of Hotham Inlet eastward, and it has a large river, Selawik River, emptying into it at its head.

From Hotham Inlet to Cape Krusenstern the coast is a low beach. The shoal water from the mouth of the inlet extends nearly halfway to the cape; the face of the shoal is steep and should be approached carefully. From where the shoal joins the land to Cape Krusenstern there is good water close in, with regular soundings.

Cape Krusenstern.—Back of Cape Krusenstern there is a high, prominent range of mountains, which can be seen at a long distance. On nearer approach the mountains are seen to fall away to the cape in a series of steps, and, in shaping a course into the sound, these cliffs, or steps, must not be mistaken for the cape, which is a low point extending about 3 miles westward of them. A shoal extends about 2 miles westward and northward off the point of the cape.

From Cape Krusenstern to Cape Seppings the coast is a low, shingly beach, back of which is a series of lagoons, which discharge their waters through small, shallow openings. The high land of Cape Krusenstern extends along this coast some distance inland, terminating in the Mulgrave Hills, about 30 miles northwestward. After passing Mulgrave Hills the land is an extensive plain until in the vicinity of **Cape Seppings.** Here the mountains approach close to the coast and slope down to the shore. Cape Seppings and Cape Thompson are not distinct, and it is difficult to determine the points to which the names should be applied.

In the vicinity of **Cape Thompson,** for a distance of 6 miles, the mountains break off directly to the water in a series of abrupt cliffs about 500 feet high. The shore line is generally straight and there are no distinct promontories in the line of cliffs. What was probably named Cape Thompson is a rugged mountain face, about in the center of this line of cliffs, having at its southern end a very distinct series of strata, in the form of an irregular semicircle. In the ravine south of this point there is a small stream, from which good water can easily be obtained. Directly off the watering place anchorage may be had in 5 fathoms, sandy bottom. At other points along the cliffs the bottom is generally rocky.

From Cape Thompson the mountains continue north-northwest to Cape Lisburne, while the coast curves to the northwestward and westward to Point Hope.

Point Hope is the western extremity of a low tongue of land which projects almost 16 miles from the general line of the coast mountain range. It has a steep shingle beach, and its surface is broken by a number of lagoons. The largest of these, **Marryat Inlet,** has its entrance on the north side, close to where the coast trends northward, and a draft of 10 feet can be carried through the entrance. For a number of years some small schooners have been using this inlet as a place to winter. Those not familiar should sound out the channel before entering. In the first of the season, when the ice breaks in the inlet, there is a strong current running out and the moving ice is more or less dangerous. There is a large native village on the end of Point Hope, and scattered on the south side, from the end of the point to Cape Thompson, are a number of whaling stations conducted by white men, which are maintained throughout the year.

In the bight just north of the high land of Cape Thompson the water is somewhat shoaler than farther west, though the soundings are regular. Seven miles east of Point Hope there is a 3-fathom shoal nearly 1 mile offshore. As the point is approached the water deepens, and toward its end 8 fathoms can be carried to within ¼ mile of the beach. The tip of the point is very bold, there being 13 fathoms a few ships' lengths from shore: but on rounding the point to the north side the soundings decrease rapidly to 5 fathoms ½ mile from shore, and, in general, the water in the bight on the north side of the point is shoaler than on the south side. At the mouth of Marryat Inlet shoal water extends off some distance.

There is a narrow shoal with a depth of 4 fathoms at its southern end and lying about 2½ miles **NW.** from Point Hope. This shoal extends in a general **WNW.** direction for a distance of 3 miles from the 4-fathom spot, and has a general depth of 5 to 6 fathoms over it.

From the mouth of Marryat Inlet to Cape Lisburne the mountains lie along the coast and terminate at the shore line in rugged, rocky cliffs. There are a few ravines through the cliffs, having running streams, with beaches at the shore, where fresh water can be obtained.

Cape Lisburne is a bare, brown mountain, 850 feet high, forming a rugged headland that is distinctly marked by the number of pinnacles and scattered rocks near its summit. Its faces at the shore are very steep. At the cape the shore line changes its direction abruptly to **E.** by **N.** There are no outlying rocks, but there is a ridge extending 5 miles to the northeastward from the cape, on which 5 fathoms can be found at a distance of 2 to 3 miles from the land. Off this cape the wind rushes down from the mountains in gusts of great violence and varying directions, and with offshore winds vessels should keep well off the land in passing.

From Cape Lisburne to Cape Sabine the land is lower and loses the rugged character of that southward of the former cape. The hills are rounded and rolling, regular in outline, and slope to the sea. Toward Cape Sabine the land becomes a series of ridges and valleys running inland; both terminate at the coast in bluffs.

Cape Sabine is the end of one of these ridges, and projects but slightly from the general line of coast.

Coal.—Veins of coal are found from Cape Thompson to Cape Beaufort. In the face of the bluffs at Cape Sabine some veins, varying in thickness from 1 to 4 feet, have been worked by whaling vessels. The veins show plainly along the top of the bluffs directly at the shore. The use of the coal is limited, owing to its poor quality and the difficulties in obtaining it, and it is not recommended to depend upon it except in case of necessity.

From Cape Sabine to **Cape Beaufort** the land continues of a rolling character until nearing the latter cape, which is a dark mountain coming down directly to the shore. There is no break in the shore line at the cape, and it probably received its name as such because seen at a distance. This is the most northern extension of high land on the coast of Alaska. The mountains at this point trend inland and the coast continues low.

The bight from Cape Lisburne to Cape Beaufort is comparatively shallow, but the bottom is regular, and anchorage may be had anywhere alongshore from 1 to 2 miles from land. Directly off Cape Beaufort the water is shoaler than elsewhere between it and Cape Lisburne. There are numerous valleys along this part of the coast, nearly all of which have streams of good water. North of Cape Beaufort it is almost impossible to obtain fresh water on the coast.

About 10 miles north of Cape Beaufort is the southern end of a large **lagoon**, which stretches along the coast without a break to within a few miles of Wainwright Inlet. Separating this lagoon from the ocean is a narrow strip of sand beach, elevated but a few feet above the water, with several small, shallow openings through it south of Icy Cape, and two considerable openings north of that cape. The land on the inside of the lagoon is generally low, but in coasting along, some small bluffs with low, rolling land back of them can be seen in places. South of Icy Cape the lagoon has three large rivers emptying into it, and its whole extent is filled with flats and bars that make it scarcely navigable even for native canoes. North of Icy Cape the water in the lagoon is deeper. Through an opening about 10 to 12 miles from the cape 8 feet of water can be safely carried, with from 2 to 3 fathoms inside. The channel is close to the sand spit on the south side of the entrance. Another opening, 10 to 12 miles farther north, is somewhat shallower.

Point Lay and **Icy Cape** are merely bends in the sand spit forming the coast. Both places can be distinguished by some hummocks on the beach. The beacon formerly marking Icy Cape is partly gone, and is now difficult to make out.

From Cape Beaufort to Icy Cape the bottom is regular, and the shore can be approached closer than in that part of the bight west of the former cape. When coasting it should be remembered that off the openings into the lagoon the water is shoaler than on either side.

Blossom Shoals extend 6 to 8 miles off Icy Cape, and consist of a number of banks parallel with the shore. These shoals are greater in extent than shown on any chart, and, from the grounding of vessels and observation, appear to be spreading. In approaching the shoals the bottom is lumpy and the soundings irregular. Of late years, on account of frequent grounding in unexpected places about the edge of the shoals, the whaling vessels all unite in giving them a wide berth; and it is recommended that vessels rounding Icy Cape should keep outside of 12 fathoms.

Wainwright Inlet, about 40 miles from Icy Cape, is a moderate-sized lagoon, and has a river emptying at its head. Its entrance, between Point Marsh and Point Collie, is a narrow, difficult channel, through which 8 to 10 feet can be carried. Inside the water is deeper. Off the mouth of the inlet the water is shoal fully 1 mile from land.

The coast from Point Collie to Point Belcher is a continuous line of mud cliffs until within a few miles of the latter point.

At **Point Belcher** the coast again becomes a shingle beach, with lagoons inside, and back of it low, rolling hills, which are higher than any other land that can be seen north of Cape Beaufort. North of the point the coast continues in a very low sand beach to Sea Horse Islands.

Sea Horse Islands and **Point Franklin** are the highest points of a continuous sand bank which extends from a point 8 miles north of Point Belcher to Point Franklin, thence turning abruptly east to the mainland at Peard Bay incloses a large lagoon. The first two islands from Point Belcher are higher than the rest of the bank, and their position seems to be permanent. The openings between the islands are, as a rule, very shallow and continually changing. Former openings are now closed, and openings now occur in the positions of former banks. Point Franklin is a very small sand island, with several hummocks on it. It is so small and far removed from the other islands that it is not easily made out. The greatest changes in the bank occur in that part of it between Point Franklin and Peard Bay, of which what is above water is merely a narrow strip of sand.

In the vicinity of Sea Horse Islands the water is shoal, especially off the openings and Point Franklin. Off Point Franklin a shoal makes out several miles northward and northeastward, and vessels rounding the point should give it a berth of 4 to 5 miles.

Peard Bay, eastward of Point Franklin, is a deep bight, which is often used by whalers in heavy southerly and southwest winds, and for protection from ice when it sets toward the shore. The bottom of the bay is regular, and the soundings decrease gradually to the shore. The water is deeper along the mainland than on the south side along the sand spit making out to Point Franklin.

The coast from Peard Bay to Cape Smyth is a line of mud cliffs from 25 to 70 feet high, being highest at what is called Skull Cliff. From this point they become gradually lower to Cape Smyth, where they end. The coast curves regularly northward, and there are no projecting points. The cliffs are broken by numerous small rivers. There are beaches at the mouths of the rivers, but little or none along the face of the cliffs.

Cape Smyth is not a projecting point, and can not be distinguished as a cape. There is a large native village at the end of the mud cliffs at this point. The United States signal station and refuge station, formerly here, are not now maintained, but there is a large whaling station conducted by white men.

From Cape Smyth to Elson Bay the coast is low with a grassy plain back of it; but from the head of Elson Bay to Point Barrow the coast is a narrow sand spit.

Offshore from Refuge Inlet to the head of Elson Bay the water is deep, and soundings of 15 fathoms are found about 2 miles from the land. The water then shoals evenly to 7 fathoms at about 1 mile from shore. The depths then lessen rapidly to from 2½ to 3 fathoms about ¾ miles offshore, where there is a slight ridge shoved up by the ice, and which in the early part of the season is always marked by heavy ground ice. Inside and close to this ridge the water deepens again to from 3 to 4 fathoms, and vessels seek this inside passage for protection from the ice when necessary. The ridge ends in a 2½-fathom shoal about 1½ miles offshore where the high land ends and the sand spit begins at the head of Elson Bay. From this point to Point Barrow, depths of 3½ to 4 fathoms can be carried very close up to the sand spit, and there is apparently no ridge in the bottom as in that to the southward.

At **Point Barrow,** latitude 71° 23′ 31″ N., longitude 156° 21′ 30″ W., the most northern point of Alaska, the sand spit forming the coast turns abruptly eastward. There is a native village on the end of the point. Directly off the point the water is fairly bold-to, and 3 fathoms can be carried to within ¼ mile of the shore. Farther offshore the deepest water of this part of the Arctic Ocean is found. On rounding the point eastward the water becomes shoal, and the coast can seldom be approached anywhere closer than 2 miles. About 2 miles east of Point Barrow is **Moore Channel,** the entrance to Elson Bay, where H. M. S. *Plover* wintered in 1852–53–54. A shoal with least depth of 2 fathoms makes off from the point on the east side of the channel, and extends westward, from ½ to ¾ mile off the sand spit, and ends nearly opposite the native village on Point Barrow. Inside the shoal there is a channel leading to Moore Channel, with nothing less than 3 fathoms, and deeper water in Moore Channel. This channel is often used as an anchorage for protection from the ice, as heavy ice grounds on the outer shoal.

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